The Engineer.

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OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLII.—No. 3944] LONDON: FRIDAY EVENING, AUGUST 14, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Air Ministry.

FOR SALE, D.C. GENERATING PLANT. Engines, semi-Diesel, 60 B.H.P. Generators, 35 kW., Milking Boosters, Battery Boosters, Switchgear, and 220 volt Accumulator Batteries; now operating at Duxford and North Weald Air Stations. Reason for sale—change over to bulk supply.—For further particulars apply before 18th August, 1931, to SUPERINTENDING ENGINEER, Headquarters, Fighting Area, Royal Air Force, Uxbridge, Middlesex. 7375 G

Air Ministry.

APPLICATIONS are INVITED for the POST of TEMPORARY ASSISTANT TECHNICAL COSTS OFFICER in the Directorate of Contracts, on a scale rising by annual increments of £10 from £200 to £300, plus bonus varying with the Cost of Living Index Figure, and giving total remuneration at the present time of £278 to £396.

Candidates must have had Workshop and Drawing-office Experience of Metal Aircraft and experience in the Preparation of Detail Cost Estimates of Metal Aircraft and Parts.

Limits of age 25-30, subject to an extension in the case of ex-Service candidates, to whom preference will be given.

Application forms, which are returnable not later than the 27th August, 1931, may be obtained from the SECRETARY, Air Ministry (S. 1, Room 437), Adastral House, Kingsway, W.C. 2. 7378

Civil Service Commission.

FORTHCOMING EXAMINATION. PROBATIONARY INSPECTORS (MALE) in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 22nd October, 1931. 7377

Two Qualified Civil

ENGINEERING ASSISTANTS REQUIRED TEMPORARILY for the Directorate of Works, the War Office. Must have had experience in Ferro-concrete and Steel Framework for Buildings. Pay, £3 18s. a week.

Preference given to ex-Service applicants suitably qualified.

Applications, which should state age, qualifications and experience, should be sent to the UNDER SECRETARY OF STATE (C. 5), the War Office, Whitehall, London, S.W. 1, not later than 19th August, 1931. 7376

Robert Gordon's Technical

COLLEGE, ABERDEEN. (CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the PROVISION OF COURSES, leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of—

CIVIL ENGINEERING.
MECHANICAL ENGINEERING.
ELECTRICAL ENGINEERING.

FULL-TIME DAY COURSES in MECHANICAL and ELECTRICAL ENGINEERING lead to the Higher National Diplomas in these subjects.

Prospectuses forwarded gratis on application to the SECRETARY and REGISTRAR, Robert Gordon's Colleges, Aberdeen. 7367

University of Manchester.

FACULTY OF SCIENCE.

DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, lead to the University Degree in Civil, Mechanical and Electrical Engineering. Students who have shown exceptional ability during the first year are admitted to the Honours Courses. A prospectus giving full information may be obtained on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 8th.

DEPARTMENTS.

Professor A. H. Gibson, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor Robert Beattie, D.Sc. (Electrical Engineering).
Professor D. R. Hartree, M.A., Ph.D. (Applied Mathematics).
Professor L. J. Mordell, B.A., M.Sc., F.R.S. (Pure Mathematics).
Professor Arthur Lapworth, D.Sc., LL.D., F.R.S. (Chemistry).
Professor W. L. Bragg, M.A., M.Sc., F.R.S., Nobel Laureate (Physics).
Professor F. C. Thompson, M.Sc., D.Met. (Metallurgy).
Professor W. J. Pugh, O.B.E., D.Sc., B.A. (Geology). 7366

TO CONTRACTORS.

Builth Wells U.D.C.

WATER SUPPLY.

The Builth Wells U.D.C. are prepared to receive TENDERS for the CONSTRUCTION of TWO SMALL CONCRETE DAMS at Pant-y-llyn, and about 782 yards of 4ins. diameter and 135 yards of 3ins. diameter CAST IRON DISTRIBUTING MAINS.

Copies of the form of Tender, general conditions of contract, specification, bill of quantities and drawing, may be obtained on application to the Engineers, Messrs. Lewis and Lewis, 15, Victoria-street, Westminster, S.W. 1, on and after the 17th day of August, 1931. Applications must be accompanied by a deposit of £1, which will be refunded after the receipt of a bona fide Tender and the return of the drawing to the Engineers. Copies of the drawing and documents may also be seen at this office.

Tenders, which must be made on the form supplied, are to be forwarded, together with a signed copy of the documents, with the bill of quantities fully priced out, in a sealed envelope endorsed outside "Tender for Builth Wells Waterworks." The sealed envelope is to be enclosed in an outer envelope and delivered to the Clerk, Council Offices, Builth Wells, Breconshire, on or before Thursday, September 3rd, 1931.

The Council do not bind themselves to accept the lowest or any Tender.

REGINALD J. OWEN,
Clerk to the Council.

Builth Wells. 7380

The Engineer

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PUBLIC NOTICES.

Administrative County of

LONDON.

The London County Council invites TENDERS for the EXECUTION of the undermentioned WORKS:—

(a) ALTERATIONS and ADDITIONS to LOW-PRESSURE HOT-WATER HEATING APPARATUS in Nurses' Homes, &c., at Brook Fever Hospital, Shooter's Hill, Woolwich, S.E. 18.

(b) INSTALLATION of HEATING APPARATUS in the Male Workshops at Darenth Training Colony, Dartford, Kent.

The specification, form of Tender, &c., in respect of each of the above works may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, on and after 12th August, 1931, upon payment of £1 by cheque, draft, or money order to the order of the London County Council.

This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 24th August, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX.
7370 Clerk of the London County Council.

The Civil Engineers Appoint-

MENTS BOARD, 8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training and experience. P1305

PUBLIC NOTICES.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that

NITRALLOY LIMITED, of Norris Deakin Buildings, King-street, Sheffield, Yorkshire, and NITRICASTIRON COMPANY, Limited, of Norris Deakin Buildings, King-street, Sheffield, Yorkshire, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 174,580, granted to Fried. Krupp Aktiengesellschaft, for an invention entitled "Improvements in a Process for Hardening Steel Alloys."

Particulars of the proposed amendment were set forth in No. 2220 of the Official Journal (Patents), published on August 6th, 1931.

Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
7382 Comptroller-General.

THE

College of Estate Management

REQUIRES an ASSISTANT, with General Municipal Experience and special experience in Town Planning and Road-making for LECTURING, &c.

Candidate with Testamur of Institution of Municipal and County Engineers and A.M.I.C.E. preferred.

Commencing salary, £600 with prospects.

Applications should reach the SECRETARY OF THE COLLEGE, 35, Lincoln's Inn-fields, W.C. 2, not later than 14th September, 1931. 7368

SITUATIONS OPEN.

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TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

BOX P1278—Situation has been filled.

W. J. JENKINS & CO., Ltd.—Situation has been filled.

SITUATIONS OPEN (continued)

WANTED, LONDON.—ASSISTANT PRODUCTION ENGINEER, accustomed Electrical and Furnace Work. Also ONE or TWO DRAUGHTSMEN REQUIRED, accustomed Furnace Work.—Address, 7390, The Engineer Office. 7390 A

CIVIL ENGINEERING DRAUGHTSMAN REQUIRED TEMPORARILY in Railway Engineer's Office in London, with experience in General Constructional, Reinforced Concrete and Building Work.

Address, stating age, experience, and salary required, 7358, The Engineer Office. 7358 A

COMPRESSED AIR SALES.—DEMONSTRATOR for India, with knowledge General Engineering. Must have had practical experience of Air Compressors and Pneumatic Tools; 3 years' agreement. Salary according to qualifications.—Write full details of experience to "L.G.," c/o Charles Barker and Sons, Ltd 31, Budge-row, E.C. 4. 7379 A

SUPERINTENDENT WANTED, Engineering Workshops, about 500 men. Light Machining, Sheet Metal Work and Assembly; little repetition. Able organiser and disciplinarian.—Write Box 925, W. S. Crawford, Ltd., 233, High Holborn, W.C. 1. 7383 A

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THREE Smart MECHANICAL DRAUGHTSMEN REQUIRED (age 25-30) in S.W. London. Experience in Sheet Metal and Light Steel Work an advantage. State age, experience and salary required.—Address, P1398, The Engineer Office. P1398 A

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SITUATIONS WANTED.

CIVIL ENGINEER (25), B.Sc., 3 Yrs. with Contractor in England on main drainage, underpinning and railway jobs and 3 yrs.' foreign experience with oil company, just returned home, REQUIRES SITUATION. Able, fit, willing to go abroad, used to native labour.—Address, P1382, The Engineer Office. P1382 B

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G.I.MECH. E., A.M.I. Loco. E. (26), Pupilage with rly. co., 1 yr. D.O., 3½ yrs. inspection locos., &c., for well-known consulting engrs., England and Continent. German and French. Ex. refs.—Address, P1379, The Engineer Office. P1379 B

HIGH-SPEED DIESEL ENGINEER, Five Years' experience with British and German engines, would like to REPRESENT good FIRM in Scotland.—Address, DIESEL, Wm. Porteous and Co., Glasgow. P1388 B

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SITUATIONS WANTED (continued).

DRAUGHTSMAN (27), 5 Years Tech. College, 5 years shops, 6 years D.O., gears and general experience, 11 years one firm, WOULD LIKE CHANGE.—Address, P1395, The Engineer Office. P1395 B

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Examinations
OF THE
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UNIVERSITY OF LONDON, &c.
ARE PERSONALLY CONDUCTED BY
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Oxford Correspondence College,
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THOROUGH POSTAL PREPARATION FOR:—
B.Sc. (ENGINEERING), Pass and Honours.
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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford St., London.
P1370 I

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New, several 11ft. long by 5ft., Recs. 80 lb. W.P.
Lancashire Boiler, 30ft. by 7ft., 80 lb. W.P.
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Ditto 30ft. by 7ft.
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5840 G

FOR SALE.

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16in. by 6in. R.S.J.;
15in. by 4in. Channels;
6in. by 6in. by ½in. Angles, Tees, &c.
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FOR SALE.
Nearly new 1500 K.W. STEAM TURBINE GENERATING SET by BELLISS & MORCOM, new 1926, coupled through reduction gear to B.T.H. Generator, 225 volts D.C., 6670 amps., 500 r.p.m. Surface Condenser, 3 circulating pumps; direct coupled to 55 H.P. Motor.
This is a special set and is arranged to by-pass 8400 lbs. of steam per hour at 40 lbs. per sq. inch for process work. Initial pressure 140 lbs.
1500 K.W. MOTOR GENERATING SET, comprising 1600 H.P. Sychronous Motor by Metro-Vick, 6600 volts, 3 phase, 50 cycles, with Exciter; direct coupled to 1500 K.W. D.C. Generator by B.T.H., 225 volts, 6670 amps., 500 r.p.m. Complete with Switches, etc. New 1926.
GEO. COHEN, SONS AND CO.
LIMITED,
600, COMMERCIAL RD. EAST, LONDON, E.14.
Tel.: East 6060. Telyms.: Coborn, London.

FOR SALE:—¾ Yard Erie STEAM SHOVEL; road wheels.—Address, 7387, The Engineer Office. 7387 G

FOR SALE, THEODOLITES.
DRAWING INSTRUMENTS, SECOND-HAND.
CLARKSON'S, 338, High Holborn, W.C.
(Opposite Gray's Inn-road).

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comprising:—
9 Passenger Coaches, 1st, 2nd and 3rd class.
4 Brake Vans.
14 Covered Goods or Cattle Wagons.
2 Oil Tank Wagons.
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1500 TONS RAILS, 41½ and 50 lbs. section.
New Rolling Stock, Spare Parts, etc.
FULL DETAILS ON APPLICATION.
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THE CHATWOOD SAFE COMPANY, Ltd., of Harlescott, Shrewsbury, will have for DISPOSAL at the end of November, in consequence of the Change Over to the Grid System, the following POWER GENERATING PLANT:—
TWO Ruston-Hornsby DIESEL ENGINES, 100 kW, 300 r.p.m.
ONE Hick Hargreaves DIESEL ENGINE, 80 kW, 3-cylinder, 300 r.p.m.
The above are coupled to LANCASHIRE DYNAMO ALTERNATORS, 400-430 V., 50 periods, 3-phase.
This plant may be inspected running at any time by appointment. P1389 G

FOR SALE.

FOR SALE.

STEAM TURBO-ALTERNATOR, by the British Thomson-Houston Co., Ltd., Rugby, having a continuously rated output of 2000 kW at 3000 revs. per minute, 3-phase current, 440 volts, 50 cycles, complete with exciter on extension of alternator shaft.

Working steam pressure, 175 lb. per square inch, superheated to a temperature of 520 degrees F.

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The plant, which was shut down a few days ago, is in good working order, and is installed at the mills of THE ACME SPINNING CO., Ltd., Pendlebury, nr. Manchester, to whom application should be made for permission to view. 7388 G

THIRTY AIR RECEIVERS, all Welded, 8ft. 4in. long by 22in. dia., 2 screwed tappings and plugs 1¼in. dia. Tested to 250 lb. per sq. in. hydraulic.
THIRTY-TWO AIR RECEIVERS, all welded, 3ft. 5½in. long by 15in. dia. (as used on H.M. Submarines).
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ALBION WORKS, SHEFFIELD.

WINKWORTH, MACHINERY, STAINES.—400-kW Belliss and Morcom-Siemens STEAM SET, 220 v., with surface condenser, 350 H.P. Motor, date about 1928, 220 v., 600 r.p.m., with enclosed "Reynolds" Chains and Brookhirst "Starter, 48in. Forced Draught Fan, by Musgrave. Bargain prices before removal. 7329 G

For continuation of For Sale Advertisements see page 78.

Spencer-Bonecourt Patent Waste Heat Boilers.
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Engineers, Colchester.
Water Screens, Pennell Wylie Filters, Pumps, Air Compressors, Iron Castings, etc.

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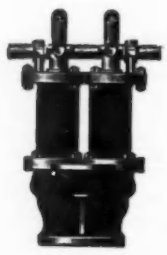

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A Seven-Day Journal

Rotating Wireless Beacon Transmitters.

From the British Air Ministry, Marconi's Wireless Telegraph Company has acquired the commercial rights and drawings for the design and erection of rotating wireless beacon stations. For many years the company has specialised in the design and construction of wireless direction-finding equipment, and by the acquisition of the commercial rights for the rotating type of beacon, it is now able to offer a valuable alternative to its previous equipment, both for aerial and maritime navigation. Experimental rotating beacons erected at Orfordness, Gosport, and Farnborough have been subjected to exhaustive tests by the Air Ministry, the Radio Research Board, and other authorities, and in all cases the results are said to have proved satisfactory. By means of the rotating beacon system, bearings can be taken on a ship or aircraft by means of an ordinary wireless receiver and stop watch. A rotating beacon to be erected by the Marconi Company at Rangoon will be similar to the station just built by the Air Ministry at Farnborough, which is of the most recent design, and incorporates a number of new improvements. It will operate on a wave length of 1050 m., corresponding to a frequency of 285 kilocycles, with a maximum power of 2 kW at the anodes of the transmitting valves. The system of operation will be to transmit a series of signals commencing at 15, 20, 35, and 50 minutes past each hour, the first minute of each transmission being utilised for signalling the identification letters V U R of the station. As practically all ships of any size using the port of Rangoon are fitted with wireless receivers, it is considered that when navigators have become accustomed to the operation of the rotating beacon, it will be possible to dispense with the existing lightship.

Flood-lighting in London.

A few days ago it was announced that as the result of the success of the experiments in connection with the flood-lighting of London, which is to be the signal of welcome to the home and foreign delegates of the International Illumination Congress, which meets for the first time in England on September 1st, it has been decided to extend the flood-lighting period from one week to four. An hour or so before sunset on the days between September 1st and 26th sightseers will be able to view historic London buildings and familiar thoroughfares in a setting never before rivalled. At the outset, the illumination will begin at 9 p.m., and will last until midnight, but after September 10th the lighting-up time will be 8.30 p.m. A special exhibition of aerodrome and aircraft lighting at Croydon between 11 p.m. and 1 a.m. on September 2nd, will represent the most up-to-date practice. With the co-operation of well-known stores and hotels, flood-lighting will be a conspicuous feature of Regent-street, Piccadilly, Kensington High-street, and many other popular shopping centres. In connection with the International Illumination Congress and the Faraday Centenary Celebrations, which will immediately follow it, the principal buildings and some castles in towns throughout the country will be treated in this way.

The Air Liner Hannibal.

The four-engined air liner "Hannibal," of Imperial Airways, Ltd., the first of eight new liners which are being constructed by Handley Page, Ltd., for the London–Paris and Empire services, was severely damaged on Saturday morning last, August 8th, whilst making a forced landing at Tudeley, near Tonbridge. Owing, however, to the very skilful handling of the machine by Captain F. Dismore, the chief pilot, the eighteen passengers escaped injury or shaking, and later resumed their journey to Paris in another machine. The descent was caused by the failure near Tonbridge of one of the engines, it being supposed that a piece of metal struck one of the propellers, causing a fracture which was followed by severe vibration. In making the landing one wing of the machine came into contact with a telegraph pole, while the tail was torn by three tree stumps. The hull structure itself sustained no injury whatever, which is a tribute to the design and structural strength of the hull. Early in the week it was decided to dismantle the air liner and to take her back to Croydon Air Port on special Handley Page motor lorries, which have been designed for the transport of large wing structures. An official Air Ministry inquiry will be held, and a report submitted to the Secretary of State for Air.

A Large Coal Shipping Plant for Grimsby.

A large coal-shipping installation, with a designed capacity of 1600 tons per hour, is to be erected on a new jetty at the Royal Docks, Grimsby, which is to be built by the London and North-Eastern Railway Company. The plant will consist of four sets of double wagon tipplers operated hydraulically, and designed to handle 20-ton coal wagons. Below the tipplers there will be steel hoppers with apron feeders, controlling the coal delivery. From the hoppers there will be four bulk conveyors to a junction house built on the jetty, and four further conveyors leading to structural steel towers for loading out. The towers are to be erected at two points on the jetty. The first group of four conveyors will have lengths ranging from 450ft. to 550ft., while of the second group of four conveyors two will be 250ft. long and two 580ft. long, all having a handling capacity of 400 tons of coal per hour. The towers are to have a height of about 75ft., and at the top there will be mounted a revolving crane carrying the anti-breaker shoots. Each tower will be furnished with two loading-out conveyors, arranged for luffing, slewing, and telescoping, with a maximum length of about 46ft. On the outer conveyor of the first group there will also be two loading berths for delivering coal to trawlers and other small craft. The whole of the plant referred to, including the coal-handling machinery in the towers, and the gantries to carry the lines of conveyors, will be supplied by Henry Simon, Ltd., of Cheadle Heath, near Manchester.

The Schneider Trophy Race.

At the end of last week the official arrangements of the Royal Aero Club for the Schneider Trophy Race on September 12th were made known. The race will be flown over a triangular course above the Solent and Spithead, the turning points being fixed at positions north-east of Cowes, north of St. Helens, and close to the coast at West Wittering, on the eastern side of Chichester Harbour. This year's contest will differ from that of 1929 in that the preliminary trials, which include a take off, a climb to about 150ft., a landing, and a taxi-ing test of about two minutes' duration, will immediately precede the speed tests, and form part of one continuous contest. The circuit will provide a course of 50 kiloms., or about 26·98 sea miles or 31·07 land miles, and will be flown round anti-clockwise seven times, making a total distance of 350 kiloms. The contest is timed to begin at 12.30 p.m., in order to obtain the best tidal conditions as between that hour and 4 p.m. there will be plenty of water over the sand banks and over Chichester Harbour, making conditions practically identical for the first and the last planes to start. The port of Southampton will be closed during the race. On Tuesday, August 11th, by invitation of the (Vickers) Supermarine Aviation Works and Rolls-Royce, Ltd., the two firms responsible for the two new machines and their engines, a demonstration of the new Vickers Supermarine Rolls-Royce S. 6 machines was arranged at the Calshot Air Base, when members of the party met the members of the High-speed Flight Unit which is now in an advanced state of training under Squadron Leader Orlebar. The weather was ideal for flying, and the machines were seen to advantage.

A New Clyde Engine Works.

Although the twin industries of marine engineering and shipbuilding are now passing under a severe depression, it is not the time to stand still, and the Clyde is seeking to attract new industries and to develop existing business in its area. In this connection it is of interest to note that a new company has been formed to carry on under one management the marine engineering work which was previously undertaken by two firms, M'Kie and Baxter Ltd., of Copland Works, Govan, and Campbell and Calderwood, Ltd., of Paisley. The new company will be styled M'Kie and Baxter, Ltd., and its address will be Copland Works, Murray-street, Paisley. Its active directors will consist of members of the administrative staffs, who have had many years' experience in the special class of work carried out by the two firms which have now amalgamated. The original M'Kie and Baxter firm was founded about 1896 by the late Mr. J. A. M'Kie and the late Mr. Peter MacLeod Baxter. The works at Copland-road, Govan, were gradually increased, and engines from the smallest outputs up to 5000 I.H.P. were built. During the war period the firm's annual output of marine engines approached 40,000 I.H.P., while on many occasions complete contracts for steamships were undertaken by the firm, the hulls being built by sub-contracting shipbuilding firms. The Paisley firm of Campbell and Calderwood, Ltd., is also well known in marine circles, and has a long record in specialised marine engineering work.

The United States Naval Airship Akron.

On Saturday of last week, August 8th, the airship "Akron," the first of two airships to be built for the United States Navy, was safely launched from the works of the Goodyear-Zeppelin Corporation, near Akron, Ohio. The naming ceremony was performed by Mrs. Hoover, the wife of the President. The length of the new airship is 785ft., or a little larger than the "Graf Zeppelin," while the diameter is 113ft., with a useful lift of 91 tons. There are twelve lifting gas cells and their total capacity is 6,500,000 cubic feet of helium. The control cabin is the only structure protruding from the hull outline, the eight 560 horse-power engines being housed in special engine-rooms within the hull structure. The power is transmitted to the propellers through outrigger shafts, with a bevel drive, and the propellers are so arranged that they can be made to swing through a 90 deg. arc to the vertical, and are thus able to exert a downward or upward thrust, as well as the horizontal thrust which they develop in the normal position. The arrangement for varying the angle of the propellers is one which it is expected will be found very useful when landing or taking off. The hull of the ship, in addition to the gas cells, machinery, and fuel spaces, and the accommodation for officers and crew, contains a compartment in which five aeroplanes are housed. These may be lowered through a tee-shaped opening in the bottom of the hull on a trapeze arrangement, from which they can either take off or land. The "Akron" has a designed speed of 80 miles per hour, and it has been estimated that she will be able to fly for 10,500 miles without having to refuel. A special mobile mooring mast has been designed for moving the airship in and out of the docking shed. It is of the tripod type, with a caterpillar track at each corner of its triangular base. The mast is designed to move at a speed not exceeding 2 miles per hour. A second airship is also under construction, the "Akron" being intended for Pacific Fleet service and the second airship for Atlantic Fleet service.

Testing Agricultural Machinery.

We have received the first report of the Agricultural Machinery Testing Committee, which, under the chairmanship of Sir W. C. D. Dampier-Whetham, was appointed in 1925 to supervise on behalf of the Ministry of Agriculture and Fisheries the conduct of tests of agricultural machinery, and to draw up certificates and reports for approval and issue by the Ministry. Since January, 1926, the Committee has received some forty-eight applications for tests, ten of which were subsequently abandoned or withdrawn, while three remain in abeyance. In its report the Committee points out that in the countries abroad where testing has been started it has developed, and its value has been proved. Sweden, for instance, owes much of its pre-eminence in the design and manufacture of dairy appliances to the testing work which has been carried out at Alpard since 1927, while in America the official tractor tests made by the University of Nebraska have done much to extend the use of the tractor for farm service. The greatest immediate need of agriculture in the way of machinery appears to be, suggests the Committee, not so much the production of a large number of new devices as the steady improvement of existing machines and the gradual elimination of the less efficient types. The Committee feels that it is along these lines that the testing scheme can play its most important part in the development of agricultural machinery to meet the present and future needs of the British farmer. In an appendix to the report the particulars relating to twenty-four tests made and certificates granted are given. We note that the engines, implements and devices tested cover a wide range, and include the products of British, Canadian, and American firms. The report is one we may recommend to all engaged in this particular branch of our engineering industry.

The Turbo-Electrically Propelled Liner President Hoover.

The "President Hoover," which started on her maiden voyage in the New York–California Orient service of the Dollar Line at the end of last week, is noteworthy as being the largest passenger liner to be built in an American shipyard. She was constructed by the Newport News Shipbuilding and Drydock Company, Newport News, and her propelling machinery was designed and built by the General Electric Company, of Schenectady. A sister vessel, the "President Coolidge," under construction at the same yard, is similar in her dimensions, but she has machinery by the Westinghouse Manufacturing Company. The length of the new liner is 653ft., with a beam of 81ft. She is designed to carry 988 passengers in four classes, and her equipment includes all the latest improvements in cabin and public-room design and arrangement. The propelling machinery of the "President Hoover" comprises two 13,250 S.H.P., 133 r.p.m. motors, which are coupled directly to the propeller shafts. The three-phase current for the motors is supplied at a pressure of 4800 volts by two main turbo-generator sets, each of 10,100-kW output. Steam is delivered at the turbine stop valves at a pressure of 275 lb. per square inch, and with 200 deg. Fah. superheat. It is raised in twelve Babcock and Wilcox standard oil-fired marine type water-tube boilers, working under cold forced draught, and designed for a working pressure of 300 lb. per square inch. The auxiliary generator sets include four 500-kW turbo-generator sets, working at full steam temperature and pressure, one of which is arranged for non-condensing working at a reduced initial steam pressure. Oil-electric emergency generator sets are also included in the equipment. On her trial run the liner exceeded her guaranteed speed of 20·5 knots at 26,500 S.H.P., while on an eight-hour test run a fuel consumption of 0·669 lb. of oil per S.H.P. hour was recorded. The sister liner, the "President Coolidge," is expected to be ready for service by the early part of October.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. I.—BENDING TOOLS.

I. The Simple Bend.

I open these articles with an attempt to correct what I believe to be generally accepted as a fact, a principle of design that is actually a fallacy. I refer to the type of tool known as a simple bending tool. The fallacy may lie solely in the description and may not be misconstrued by experts in the same manner that I misconstrued it in my early days of design; but, to say the least, the description is certainly misleading, as it almost invariably refers to a design of tool that, while forming the material to the desired shape, yet has in it the elements of a draw rather than a pure bend.

Some years ago I had to get through a quantity of pressed parts round about ¼in. square by 7in. long, with ¼in. at each end bent at right angles to the main piece. This I decided to carry out at two blows between a plain V punch and die, but was greatly troubled by the high percentage of breakages, especially as I found it possible to bend the material at right angles with hammer and vice with no breakages and to continue the bend to a double flat bend with very few breakages. At the time, I got over the trouble by substituting another type of material, which took the bend from the V die satisfactorily, and it was some time before I grasped the true significance of the information I had obtained. First, I had mistaken softness for ductility of material, and as I think it possible that others may unconsciously slip into the same error I would compare, on the one hand, hard-drawn patent wire of a spring temper, which, though comparatively hard under Brinell tests, yet can be ductile enough to take a double flat bend without annealing, with, on the other hand, common soft grey cast iron—as distinct from malleable cast iron—which, though extremely soft to work, will not take any appreciable bend without fracture.

The other points in my original error are explained by reference to the sketches, Figs. 1, 2 and 3. Fig. 1 is a hypothetical piece of steel to be bent at right angles having arms 1in. inside measurement, while the stock is ¼in. thick. The amount of length of stock absorbed by a bend is shown shaded in Fig. 1, and varies with the type of material used from one-third to one-half the thickness of the material for every 90 deg. bend. In this instance, I have allowed for the larger proportion, which gives me a blank 2½in. in length and which is shown at A in Fig. 2 in position on a plain V die. The bending edges C of the die are spaced as far as possible apart in order to reduce the "drawing" effect to a minimum, but even so the blank has to slide over the edges C—the amount shown shaded—

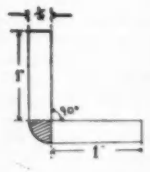

Fig. 1

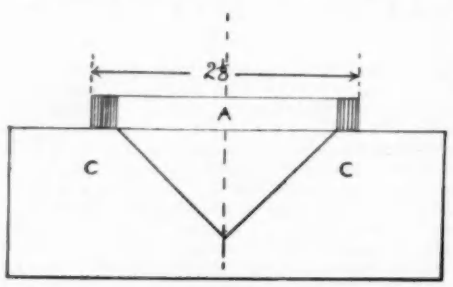

Fig. 2

and this must definitely produce a slight "drawing" effect. If the bending edges C are brought closer together, the "drawing" action is decreased, but the reduction in the drawing action is more than counterbalanced by the increased bending stress in the shorter length of stock, to which, in extreme cases, is also

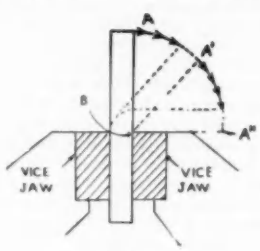

Fig. 3

added the elements of a compression strain on the metal.

Compare the foregoing with the natural and unrestrained course of the metal as shown in Fig. 3. The blank is gripped between two vice jaws and the free end—1½in. in length—is hammered over at right angles. The inside edge A passes along the arrowed line through A′ at 45 deg. and reaches A″ at right angles. The path of A is, in effect, a scroll with centre B—the inside line of the bend—and a pitch reducing ¼in.—twice the thickness of the stock—per 360 deg. To obtain the same results from tools as from hammer and vice, therefore, it is necessary to design the tools so that the actual bending point

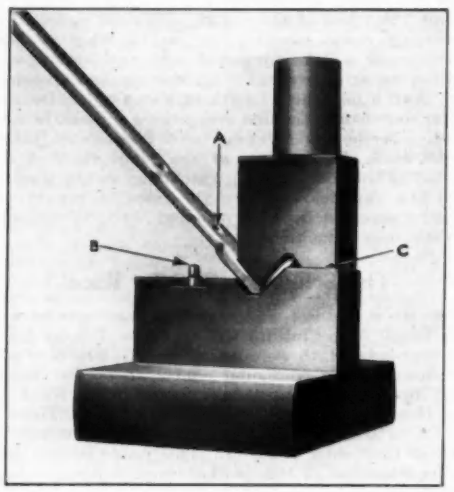

Fig. 4

of the die moves in fixed relation to the angle of the blank and this pre-ordained path, thereby allowing the metal to travel in a natural course. In practice it is not feasible to follow this aim exactly, but some approximation to it will greatly ease the stress on the metal and will enable many metals to be bent by presswork that could not be handled satisfactorily on the plain V, or, as I now term them, the "draw-bend" principle, dies. In my experience I have

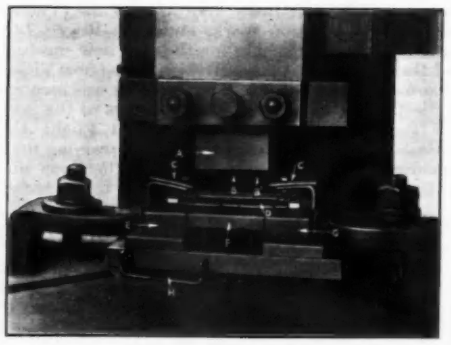

Fig. 5

found that while undue compression tendency also reduces the ductility of the metal a slight compression tendency is not so harmful in this respect as a "drawing" tendency, and this point should be remembered in reading "Compound Action Bending."

In many cases, of course, "draw-bend" dies are eminently satisfactory especially on account of their simplicity and cheapness. The engraving Fig. 4 shows a piece of ¼in. thick stock, not ductile enough

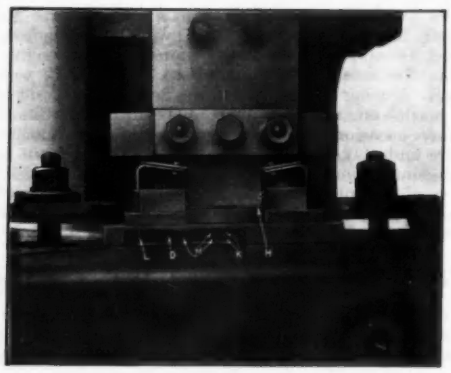

Fig. 6

for cold bending, bent hot at right angles in a simple V punch and die. The two points of interest in these tools are that the short arm has been previously flattened to half-thickness, and to prevent creeping on this account the back end of the die is raised slightly, the stock being gauged for bending from the hole A and pin B. The punch has an extension C, which acts as a dead stop and permits of the squeezing pressure from a power percussion screw press being utilised to produce a sharp finish without varying the thickness of the finished work.

Figs. 5 and 6 show a pair of "draw-bend" tools to produce a piece with two right angle bends shown at H in each from the flat blank shown at D in each. In Fig. 6 a chalk line is marked on the blank at L, showing the position of the one bend, the other bend occurring as indicated passing through the two holes K. This lessened strength on the one bend gave the blank a tendency to creep during bending, and to overcome this it was found necessary to fit locating pegs at B in the punch—Fig. 5—to engage with the three holes M in the base of the blank—Fig. 6. The locating pegs are tapered to points and accurately centre the blank from the rough back and end gauges fitted to the surface of the bending dies G and E. The pressure pad F is connected to a strong compression spring let through the hole in the press bed and has as its

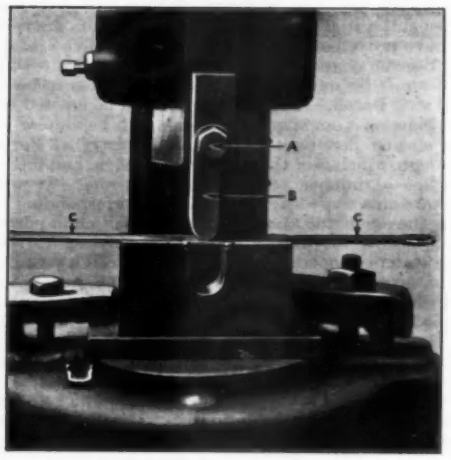

Fig. 7

main object the stripping of the bent blank from the dies, though it also exercises a braking influence on the tendency of the blank to form an extra bend in the centre, which would later be flattened out when the press reaches the bottom of its stroke. The stripping fingers C fitted to the die remove the blank from the punch A during the last portion of its upward stroke.

"Draw-bend" tools—Figs. 7 and 8—are used with the definite object of maintaining and increasing the hardness of the spring. The blank is taken from a steel that, with careful working, will produce a very satisfactory spring without heat-treatment. The severest possible "draw-bend" strain compatible with the desired shape is put on to the steel and serves the double purpose of stiffening and thoroughly testing the spring for reliability. The sharpness of the draw can be gathered from the fact that the

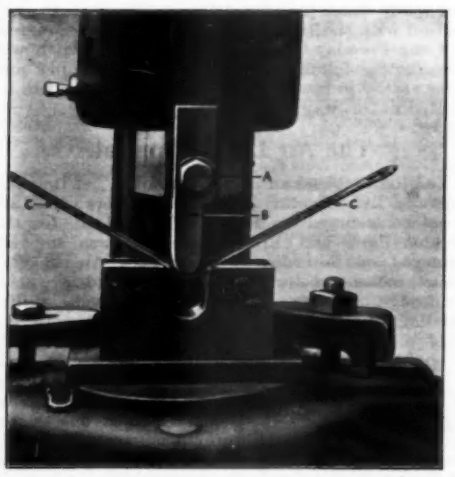

Fig. 8

engravings show the punch striking the blank and after travelling ¼in. down. It will be seen that the arms C of the blank would normally strike the press ram before the completion of the stroke, and to obviate this, the working face of the punch B is set to the front of the ram. The punch is carried well up the press ram face for support and is also carried under the ram, where it is connected to the usual round shank gripped by the bolt A. In tools of this type, especially where one side of the blank is less wide than the other, it has been found advisable to chisel-cut the striking face of the punch if holes in the blank are lacking and eliminate the possibility of locating pegs being used to prevent the blank creeping.

(To be continued.)

Geophysics.

No. III.*

ELECTRICAL METHODS.

As the various rocks, minerals, and materials comprising the crust of the earth have differing electrical properties, a variety of methods for detecting the presence of bodies below the surface, and for mapping the sub-surface structure by the use of electrical phenomena have been devised. Owing to the speed with which they can be operated and the small number of instruments required, electrical methods of surveying are perhaps used more than any other. Unfortunately, although the theoretical principles upon which many of them depend are fairly well understood and are open to discussion, it has been the policy of some users to regard as confidential any developments of their practical use that might be discovered, with the result that progress has been retarded. The publication in July of the report on the work of the Imperial Geophysical Experimental Survey in Australia may do much to clear the air of misconceptions and to give a firm groundwork on which further work may be done.

Essentially, all electrical prospecting consists in measuring on the surface the electrical effects of bodies lying beneath the ground. If these effects are to be observable, contrast must exist between the electrical properties of the bodies or rocks and the other materials in the vicinity of the survey.

THE SPONTANEOUS POLARISATION METHOD.

Electrical effects occur naturally in the earth in certain places, and the measurement of such effects gives indications of the position of the body producing them. Sulphide ores in particular give rise to strong polarisation currents if the conditions are suitable. When such a body of ore of a pyritic character lies beneath the surface with its length more or less vertical, with its lower end lying in soil beneath the water table and its upper surface projecting into a

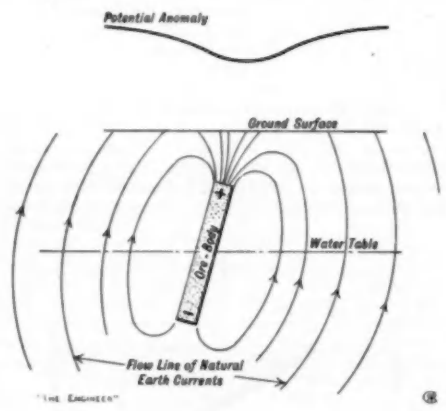

FIG. 18

region into which water in a highly aerated state can percolate oxidisation will occur at the top, which, in consequence, becomes electrically positive. Then natural polarisation currents flow from the lower end to the upper surface. It remains, therefore, only to find some means of detecting the occurrence of these polarisation currents. In practice the method used employs a galvanometer, to which are connected two electrodes. With this apparatus two methods of detection may be employed, according to the size of the ore body. One of the electrodes may be inserted in the ground and the other moved about some distance away until a position is found at which the reading of the galvanometer is zero. The first electrode may then be placed in the position the second occupied, whilst the second is again used for exploration till another zero reading is found. By repeating this operation for successive positions an equipotential line enclosing the ore body will be drawn, the position of that body being indicated by a pronounced negative centre, as shown in the diagram, Fig. 18. This diagram is a vertical section through the earth, showing the ore body with the natural polarisation currents. That very simple method, however, is only suitable for the detection of comparatively small ore bodies, and it is more usual to work along traverse lines measuring by means of the galvanometer the difference of potential that exists at each station, and to draw by interpolation the equipotential lines, when, as before, the position of the ore body will be indicated by a negative centre.

In Fig. 19 can be seen such a survey carried out by A. Broughton Edge in Cyprus in 1929. The equipotential lines are shown dotted on a contour map of the district, and it will be observed that a well-defined negative centre exists. The presence of this ore body had been suspected by geologists for some time and a number of efforts had been made to find it without success. After the completion of the spontaneous polarisation survey two adits were driven, and encountered a pyritic mass immediately beneath the negative centre.

Certain precautions must be observed if this method is to be used with success, and a foreknowledge of the general geological structure of the district is an advantage. Owing to the fact that the electrodes used may themselves become polarised so that they may give rise to currents masking those for which a search is being made, some means must be taken to

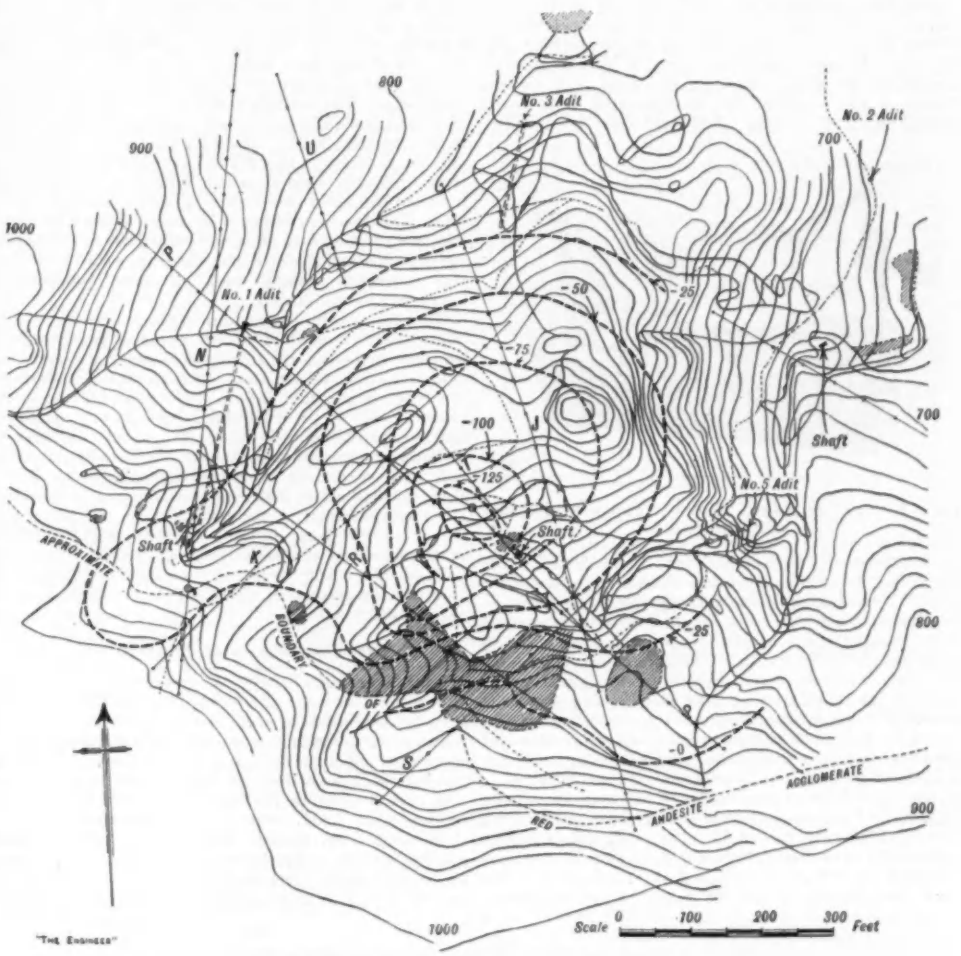

FIG. 19—SPONTANEOUS POLARISATION SURVEY

reduce this effect to a minimum. For this purpose specially constructed non-polarising electrodes, which consist of copper bars inserted in porous pots containing copper sulphate solution, are used. The fact that polarisation currents occur in the ground does not necessarily indicate the presence of an ore body. Peat bogs, for instance, set up electrical anomalies of a strength comparable with those found round

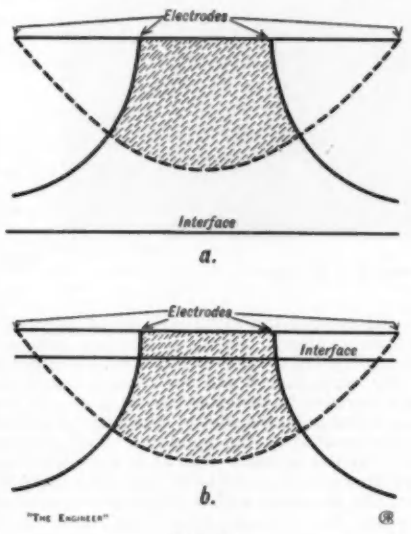

FIG. 20

ore bodies. On the other hand, the fact that no negative centre can be found does not necessarily mean that no ore body exists, since the geological structure of the neighbourhood may be such that no oxidation of the top of the body is occurring. For instance, if the overburden is clay, impervious to water, no moisture can reach the top of the body to cause oxidation, and, in consequence, the polarisation currents will be absent. It follows that the spontaneous polarisation method of survey is hardly suitable for an exhaustive search, but as an auxiliary to other methods it may be of great value in defining an area previously found to be promising.

The instrument used for survey purposes must be capable of measuring differences of potential up to 0·1 volt accurately.

RESISTIVITY METHODS.

As the rocks and minerals that form the crust of the earth have differing electrical resistances, it was early suggested that use might be made of that property for the detection of hidden bodies and structures. Difficulties, however, were met with. The determinations of electrical resistance made in the laboratory on specially prepared specimens did not agree with the resistances of large masses *in situ*, owing to the presence of moisture and the existence of cracks and irregularities of various kinds. The first attempts to measure the resistance of the soil were made by driving two electrodes into the ground, passing a known current between them and measuring the potential required to do so. It was thought that noticeable anomalies would be found in the presence

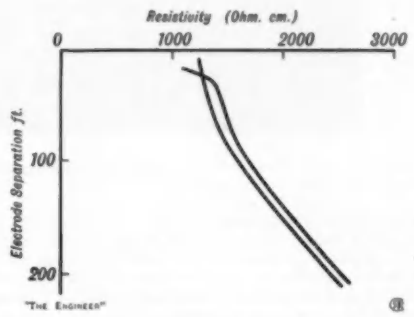

FIG. 21

of a conducting body. But no such result was obtained, and for some years no further effort was made to develop the method. In 1916, however, Wenner showed that the lack of success of the first experimenters was due to the high current density in the neighbourhood of the electrodes, the resistance at that point being great enough effectively to conceal any variations in the true resistance of the soil. He suggested that if four electrodes were placed in the ground at equal intervals along a straight line, and a current was passed into the soil between the outer two, the resistivity of the soil could be determined by taking readings of the potential difference existing between the inner two electrodes. This principle

* No. II. appeared August 7th.

has been adopted in all modern methods of resistivity surveying.

When a current is passed through the ground between two electrodes, every part of the material from the surface downwards bears a part in conducting it, so that the resistance measured depends to a certain extent upon the nature of the materials deep into the earth. However, it is fairly obvious, and can be demonstrated mathematically, that the layers near the surface have the greater influence. It will be seen, however, that the penetration will increase as the distance between the electrodes increases. In Fig. 20—which is reproduced from the report of the Imperial Geophysical Experimental Survey in Australia—a simple geological structure in which there is an interface some distance below the ground is shown. In *a* the electrodes are close together, and that part shaded indicates the material the resistance of which will affect the potentiometer. It will be seen that only the

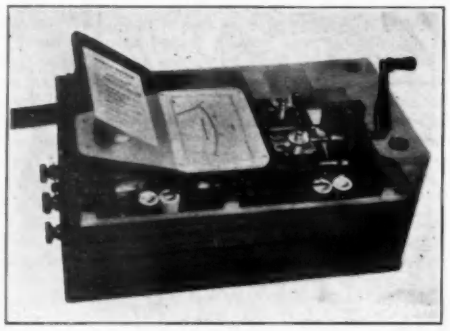

FIG. 22—THE MEGGER EARTH TESTER—EVERSHED AND VIGNOLES

resistance of the surface soil will be measured. But when the electrode separation is increased, as shown in *b*, the resistance of the surface layer will influence the instruments only to a small extent as compared with that of the material below the interface. In practice, therefore, readings are taken along a traverse line with gradually increasing electrode separation, so that the resistivity at greater and greater depths is recorded. Some doubt appears to exist as to the relation which exists between electrode separation and penetration and experimental verification of the claim advanced by some advocates that the penetration is equal to the electrode separation appears to be required. The type of result obtained is shown in the sketch Fig. 21, in which the measurements of resistivity have been plotted against depth as determined from the electrode separation. Owing to the fact that distortion may be caused by the presence

FIG. 23—MEGGER EARTH TESTER IN USE

near the surface of a conductive or resistive body, it is usual in the field to take two or more sets of readings along traverses separated the one from the others by suitable distances. Any distortion caused by some purely local structure will then be visible as a change in the shape of only one of the resistivity curves such as that shown in the sketch. In the example the resistivity is increasing steadily downwards, but in the presence of strata with highly different properties there will be considerable alterations in the shape of the curve from which the nature of the strata can be deduced.

Allowance has to be made in practice for the existence of natural earth currents such as those occurring over sulphide ores, which sometimes render the measurements difficult to make and unreliable. Polarisation may also occur at the electrodes. These difficulties may be surmounted by using non-polarising electrodes and taking readings with the current flowing in each direction, subsequently averaging the results. Another method, however, by which use is made of a double commutator on the generating machine which reverses the current direction in the ground and at the same time transposes the leads to the potentiometer, was developed by Gish and Rooney. If the reversals occur with sufficient rapidity the natural earth and electrode polarisation currents are continually reversed at the potentiometer, so that they give rise to no readings, while the applied current being reversed synchronously with the reversal of the potentiometer leads still brings about a reading. It was soon pointed out that the "Megger" earth tester made by Evershed and Vignoles was fundamentally similar to the instruments used by Gish and Rooney. Fig. 22 is a reproduction of a phantom photograph of the "Megger" showing some of the internal arrangements, while Fig. 23 shows the instrument in use. An alternating current is generated and applied to the outer electrodes. The reading is obtained from the balance of two coils rigidly connected together at right angles in a magnetic field. Through one of the coils the current applied to the ground is made to flow, while that occurring owing to the difference of potential between the inner electrodes passes through the other coil. The reading, being a balance between the two currents, is therefore obtained regardless of the actual current flowing through the circuits, while owing to the reversals natural and electrode polarisation currents are eliminated.

The foregoing description will demonstrate that the resistivity method of surveying is best adapted for the mapping of subsurface structure and the determination of depths. Considerable experience, however, is required before the results can be interpreted, and it is doubtful whether any accurate determinations could be made in the absence of previous geological knowledge. The condition of the soil with regard to moisture content, which has a very marked effect upon its resistivity, alone renders the interpretation of the results very difficult, while owing to the lack of knowledge at present extant with regard to the resistivity of various rocks and soils *in situ*, it is a matter of even greater difficulty to forecast the nature of the materials causing anomalous readings.

THE EQUIPOTENTIAL LINE METHOD.

In this method of survey a current is passed through the ground between two electrodes and equipotential lines are searched for and plotted on the ground. The assumption is made that anomalies in the shape of the equipotential lines are caused by inhomogeneities in the soil such as a body of high or low conductivity. The first practicable method was devised by Daft and Williams in 1901, and modern practice has been developed from theirs. Either D.C. or A.C., each having certain advantages and disadvantages, may be applied to the ground by means of two electrodes spaced a mile or more apart. To make good contact with the ground the electrodes are usually of the multi-point variety. Owing to the fact that in the neighbourhood of the electrodes the equipotential lines are very much curved and may, in the case of multi-point electrodes, be distorted, readings are only taken within a rectangle, the ends of which are at a suitable distance away from the points at which contact is made with the ground. Fig. 24 is a diagram showing the connections to the two electrodes from an alternator, the rectangle within which the equipotential lines can be plotted and those lines as they should appear if no ore body or other inhomogeneity exists. Within the rectangle the equipotential lines will be nearly straight if no inhomogeneity exists, so that distortions due to conductive or resistive bodies can be easily discovered. Searching is conducted by means of a flying circuit consisting of two electrodes connected either to a galvanometer or a pair of headphones with an amplifying set, according to whether D.C. or A.C. is used. One of these electrodes is inserted in the ground and the other moved until a null position is observed. This can be obtained with considerable accuracy by the use of D.C., as the galvanometer will read zero. When A.C. is used the sound in the telephones will not fade away completely and the minimum point must be found. In the presence of an ore body difficulty is sometimes experienced in finding this position of minimum sound, since an out-of-phase current is induced in the ore body and gives rise to a note in the phones. Some regard this phenomenon as an advantage, since its occurrence indicates the presence of ore, while others, taking into account the difficulty of plotting the equipotential lines, regard it as a disadvantage. Recently instruments which separate out the two currents have been constructed. By the method given above the equipotential lines can be plotted. In the presence of a conductive body these lines will spread apart, while where the body is resistant they will crowd together, the distortion in each case indicating the

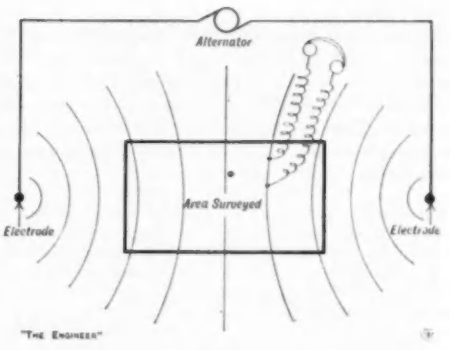

FIG. 24

position of the deposit. Where geological considerations suggest that the body lies in any particular position it is best to arrange that the equipotential lines shall lie in general across the length of the body. The distortion of the lines will then be a maximum.

Where the conditions admit, it is sometimes advantageous instead of using point electrodes to lay out straight cables connected at short intervals to the ground. The equipotential lines between the two cables will then also be straight. Unfortunately, however, it is difficult to guarantee that contact is sufficiently good at all points, and to be sure that there is no potential drop between the point of connection of the feeder to the cable and the ends.

As an illustration of the type of result to be obtained we give in Fig. 25 a sketch of an interesting exhibit shown in the Geophysical Exhibition at the Science Museum, South Kensington. Projecting upwards from the bottom of a rectangular glass tank

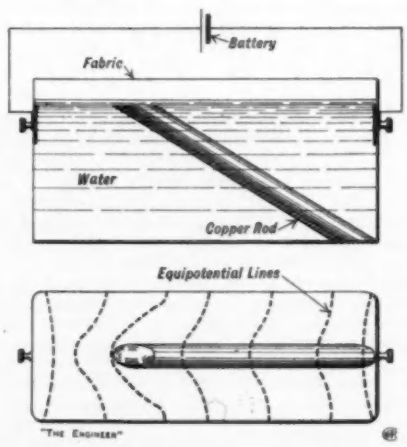

FIG. 25

filled nearly to the top with water there is a copper bar inclined at an angle of about 45 deg. to the horizontal, having its top just below the water level. Stretched over the top of the tank there is a piece of white cloth, while terminals connected to brass strips are provided at each end by means of which a current can be passed through the water. Equipotential lines have been plotted on the cloth by sticking pins through into the water and taking readings with a galvanometer. It will be seen that the equipotential lines are distorted very considerably immediately above the top of the metal rod.

In Fig. 26 the map illustrates the results of an equipotential line survey carried out by A. Broughton Edge in Northern Rhodesia for the Rhodesian Congo Border Concession, Ltd., in 1925. Before the survey was undertaken, the bodies of pyritic copper in zones A and B were known to exist. Three other zones were indicated by the survey as promising, and on exploration zones C and E were found to contain bodies of copper bearing sulphide of good quality. Zone D was not explored. If the map is examined, it will be seen that two separate surveys are included upon it, and a comparison can be made in the region

containing zones A, B and C of the shape of the equipotential lines obtained in each survey.

ELECTRO-MAGNETIC METHODS.

Although perhaps one of the most important of the geophysical methods of surveying, there has been a tendency for the users of the electro-magnetic devices to develop their own practice and to regard the results of their experiments as confidential. In consequence, less information is available with regard to the various practices in use than can be found for the other electrical methods. The principle, however, is to apply to the ground an alternating current and to examine by search coils or other devices the anomalies in the magnetic field thus produced. The current may be caused to flow through the ground between two electrodes, but more usually an induction coil, made up of a loop of insulated wire suitably disposed, is employed. The latter method has the advantages that there is no need to find positions specially suitable, as is the case for electrodes for which rocky or arid country is unsuitable, owing to the difficulty of obtaining good contact, while the inductive effect

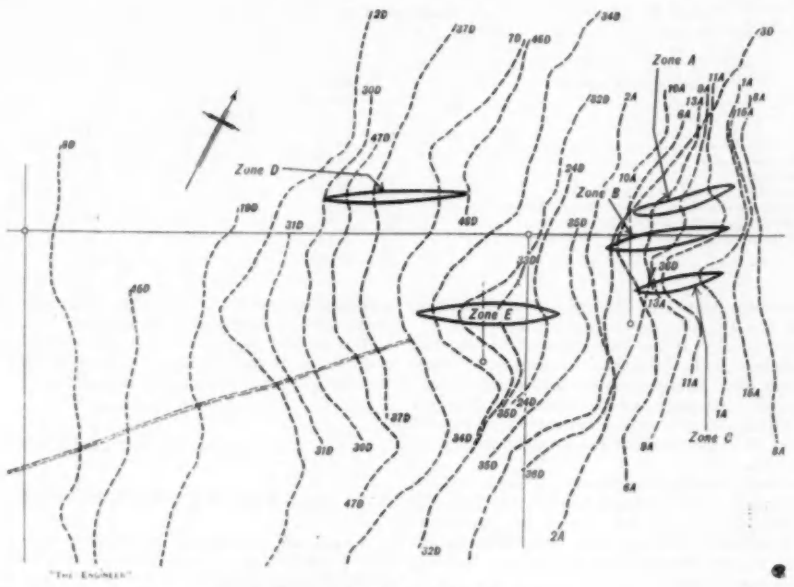

FIG. 26—EQUIPOTENTIAL LINE SURVEY

will be felt by bodies lying below an insulating stratum. Either horizontal or vertical loops may be employed, geological considerations frequently determining which it will be best to use.

When the horizontal loop method is used the exciting loop usually covers an area of about one-quarter of a square mile, and carries a current alternating with a frequency of about 500 cycles per second. Within such a loop, if it is laid over homogeneous ground, the magnetic field will be nearly vertical. If any body of high conductivity lies below the surface, however, induced currents will flow around it, giving rise to magnetic fields at the surface, with both horizontal and vertical components. There will, however, be a phase lag between the exciting field and the induced field. The search coil erected within the exciting coil is rotated until the position of maximum strength is found, this position indicating that the plane at right angles to that in which the coil lies is the direction of the horizontal component of the field. Actually, owing to the out-of-phase condition of the two superimposed fields, the resultant field is said to be elliptically polarised, and the best methods of electro-magnetic surveying investigate the nature of this field ellipse. When the survey is completed, vectors indicating the direction of the out-of-phase horizontal component and its intensity are plotted on a map of the district for each station, when an anomalous arrangement will reveal the position of a conducting body. Or a plan of the magnetic contours can be drawn by joining up points of equal vector magnitude.

While the horizontal loop is suitable for the discovery of flat-lying strata, its results are not so satisfactory when dealing with steeply dipping ores. Such ores will be more affected by the field set up by a vertical coil. In general frequencies of the order of 10,000 cycles per second are used with the vertical coil, although work may be carried out on lines similar to those employed for the horizontal coil at lower frequencies. The vertical loop induces oscillations in the ore body which re-radiates electro-magnetic waves. These waves may be detected by the search coil. Actually, however, this coil is receiving waves from the induction coil as well, and the two sets of waves will be out of phase. By altering the loop frequency and tuning the search coil, however, a position can usually be found at which the two sets of waves are brought into phase, and when this condition is reached a sharp minimum will be observed when the direction-finding coil is placed in the plane of the resultant direction from which the waves from the two sources approach it. The resultant direction found in this manner will point in the direction of interpretations of the results obtained in all but the most favourable conditions can be considered reliable in the absence of other geological indications.

(To be continued.)

Report on London Waters.

No. 1.

WE have recently been favoured with a copy of Sir Alexander C. Houston's twenty-fifth Annual Report to the Metropolitan Water Board on "The Results of the Chemical and Bacteriological Examination of the London Waters." It deals with the twelve months ended December 31st, and, as have been its precursors, it is a document which is full of interest. Following our usual custom, we propose in what follows to give an outline of its principal contents.

INTRODUCTION.

The first note struck in the opening pages is that "chlorination has come to stay." A quarter of a century ago it was looked upon with great disfavour, but the Great War taught us many lessons, "and counsels of perfection have been largely displaced by doctrines of expediency." The great majority of the water supplies in Canada and the United States are now chlorinated, and, since the treatment of Thames water in 1916, the Metropolitan Water Board has greatly extended, and is still extending, its operations in this direction, so that at the present time most of London's water is chlorinated. But the journey of the chlorinator has been beset by numerous pitfalls, and his path has been, "speaking in a reverent sense, as difficult as that of Christian in a memorable book, which, it is to be regretted, is now seldom read, if not almost forgotten." His great bugbear has been "taste." "Taste and smell, for you cannot dissociate, or divorce, these senses altogether, are wonderful things. It seems incredible that the presence in water of a one-thousand-millionth part of substances, which, in themselves, have no taste except in vastly greater concentrations, should, on the exhibition of a *tasteless dose* of chlorine, render the mixture almost undrinkable. Yet it is abundantly true, and it has required an enormous amount of research to understand and combat these difficulties." In nine hundred and ninety-nine out of a thousand—if not in all—cases, it is possible to produce a tasteless as well as a safe water supply. Infinitely small pollutions often make chlorination wellnigh impossible, so far as taste is concerned, but fortunately we have learnt to overcome these difficulties.

The best way to do so is, remarks Sir Alexander, to remove the contaminations which create taste troubles. But that is often impossible, and means have had to be devised to counteract their influence. The chief of these means are then discussed briefly. They are, in the order of the dates when they were first discovered:—Super-chlorination; permanganate and chlorine; and ammonia and chlorine. On the whole, says Sir Alexander, in the case of river-derived filtered water supplies, and when there are no contra-indicating circumstances, he thinks that the ammonia and chlorine methods of sterilisation are the most attractive.

But in spite of the excellent results obtained with various methods of sterilisation, Sir Alexander repeats his many times asserted personal feelings on the subject. He urges, "with all the power at his command," the importance of not regarding chlorination, however carefully and successfully practised, as the ultimate solution of all water problems. "We must," he says, "still seek virgin sources of water supply, still retain and maintain, as far as this is reasonably possible, the old-established armoury of defence. Chlorination should be regarded primarily as a means of amplifying a security which has, humanly speaking, already been secured."

The introduction to the Report then proceeds to discuss, successively, (1) the vitality of the typhoid bacillus in river water; (2) search for typhoid and paratyphoid bacilli in river water and sewage; (3) the vitality of the cholera vibrio in river water; (4) storage; (5) resistance to filtration; (6) the excess lime method of treatment; (7) the discharges of gulls and fish in reservoirs; (8) the condition of the River Thames as regards dissolved oxygen; (9) the sterilisation of new mains, &c. What is said under these headings is largely a résumé of what has been said in past reports, but it serves its part in constituting what forms a remarkably clear and concise discussion on water clarification and sterilisation, and the supply of potable water generally.

Passing on to the main body of the report, we find that it is divided into ten sections:—

SECTION I.—CHLORINATION OF THAMES RIVER WATER.

Originally, *raw* Thames water only was chlorinated prior to filtration. Of recent years considerable changes have been made, and at present only *filtered* water is chlorinated—namely, Southwark and Vauxhall, Kempton Park, Walton, West Middlesex, and Sunbury filtered water—with the exception of *raw* river water in the Staines Aqueduct, which is treated just below the Kempton Works on its way to the Grand Junction Works at Hampton and Kew. During 1930 the percentage number of samples of water in the Staines treatment which contained no *B. coli* in 100 c.c. was 71·6. The only Thames waters not now chlorinated are Chelsea and Lambeth.

The following excellent bacteriological results are given as regards the works when chlorination—preceded by ammonia treatment to prevent taste troubles—is practised *after* filtration:—

First-class Samples (No B. Coli in 100 c.c. of Water).

	Per cent.
Southwark and Vauxhall	98·0
Kempton Park	98·0
Walton	95·5
West Middlesex	94·4
Sunbury (six months before and six months after filtration)	92·8

The dose of chlorine varied from 0·25 to 0·3 parts per million gallons.

The treatment during the year under review was, generally speaking, remarkably successful as regards avoidance of taste troubles. There were, however, waves of *iodoform* taste of short duration in connection with the West Middlesex supply in May and August, which were believed to be due to irregular doseages and were dealt with by changing the staff of attendants. A short wave of taste also occurred in connection with the Southwark and Vauxhall Works in June. It was, apparently, due to the altered conditions arising from a changeover from Littleton to Walton stored water, and, as it was traced to the filtered water from certain of the beds before chlorination, it obviously had nothing to do with the treatment. With these two exceptions, the year 1930 was most successful from the point of view of taste troubles, especially having regard to the enormous volume of water treated.

SECTION II.—CHLORINATION OF NEW RIVER WATER.

The chlorination of the New River Water is only carried out during the winter months—from about the middle of November to about the middle of April. During the period covered by the Report, of 102 samples collected at Highfield *before* chlorination, 51·9 per cent. contained *B. coli* in 1 c.c. or less. On the other hand, of 102 samples collected at Wood Green *after* chlorination, 88·2 per cent. contained *no B. coli* in 100 c.c.—100 times as much water. The results at the outlet from the Hornsey and Stoke Newington reservoirs were not so good, being 79·4 and 12·9 per cent. negative respectively.

SECTION III.—PREFILTRATION WATERS.

All the various kinds of waters which feed the filters and which are known as prefiltration waters—

raw water, stored water, gravel water, &c.—are each week completely and thoroughly examined, chemically and bacteriologically. The underlying idea of such complete examination is that if these waters can be pronounced as epidemiologically "safe," the perfect working of the filtration process becomes almost of secondary importance, except from the point of view of securing a physically attractive product. Sir Alexander declares under this heading that he "rather feels that the pulse of the Metropolitan Water Supply is the condition of the prefiltration waters, and, holding that view, he has not scrupled to modify the work of water examination, so as to obtain the kind of information required." In considering the prefiltration result, two things should be borne in mind—(*a*) the actual results, and (*b*) the inferences to be drawn from them. Both points are important, but the latter may be of extreme significance. For example, there are certain changes that occur in water consequent upon storage, which, in Sir Alexander's opinion, clearly indicate "safety." The enormous improvement effected by storage in the bacteriological quality of the Thames, Lee, and New River waters may be observed by studying the Tables given in the Report, from which may be seen that most of the prefiltration waters were—as judged by the *B. coli* test—improved from 100 to 1000 times.

Section IV.—Barn Elms Experiments.

It will be remembered that what are known as the Barn Elms' experiments were originally started to investigate the question of the double filtration of water, first by rapid primary filters and secondarily with "slow" sand filters, working at a much higher rate than are slow filters operating by themselves. The object was to ascertain if, under such conditions of working, the filtrate from the "slow" filter, chosen for the investigation, gave reasonably good results, and also whether it was able, between successive cleanings, to filter more water than is usual. Without going in detail into all the experiments made, it may be said that, as the outcome of about seventy-six months' experience, it would seem that the following results can always be obtained, assuming comparable conditions, by the methods employed at Barn Elms:—

(1) A final product practically as good, on the average, as that resulting from the ordinary slow sand filtration process.

(2) Comparative freedom from secondary filtration troubles, owing to the useful work carried out by the primary filters.

(3) A considerably greater output per acre of filtration area—allowing for the space covered by the primary rapid filters—per unit of time.

Furthermore, with an average rate of filtration in the primary filters of 140·6 gallons per square foot per hour and an average rate of 4·56 gallons of water per square foot per hour in the secondary filter, the average number of million gallons filtered per acre cleaned during the period—16—covered by the Report was 94·5. The water feeding the primary filters was *non*-chlorinated water from Hampton after storage in the Barn Elms Reservoirs.

Next year, we learn from the Report, it will not be necessary to enter into a further description of these Barn Elms experiments, because experiments on a much larger scale are now being carried out at Walton and Kempton Park, where, our readers will recollect, there are extensive installations of rapid primary filters followed by slow sand filtration—the outcome of the Barn Elms experiments—which are in operation.

It will be of interest, perhaps, if we give in the Table I. the average chemical results attained by the original experimental filter during the period under review. It may be explained that later more rapid and secondary filters were used at this station, in addition to those originally employed.

The difference between the chemical results yielded by No. 18 filter and the filters generally was immaterial. As regards the number of bacteria, the reduction over the whole period was from 52 to 5·5—inclusive figure—or nearly 90 per cent.

Section V.—Walton Works.

At the Walton works—which were described in our issues of June 16th and 23rd, 1911, and July 30th and August 6th and 13th, 1926—*raw* Thames water is first stored in the Walton Reservoirs, then filtered—without coagulant, through primary filters at high speed; then filtered through secondary filters worked at a considerably higher rate than is customary with slow sand filters; and, finally, the filtered water is treated first with ammonia and then with chlorine.

Table I.—*Average Chemical Results* (*Parts per* 100,000).

Water.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Chlorides expressed as chlorine.	Oxygen absorbed from permanganate (3 hours at 80° F.)	Colour m.m. brown—2ft. tube Burgess's tintometer.
Stored unfiltered water	0·0042	0·0147	1·84	0·160	48
Mixed filtrates (from rapid filters)	0·0011	0·0103	1·84	0·137	40
No. 18 filter well	0·0007	0·0067	1·85	0·107	29
All the filtered water at the Barnes and Barn Elms Works, including filter No. 18	0·0111*	0·0057	1·85	0·092	29

* It is explained that this high figure is due to the artificial addition of ammonium sulphate before chlorination to prevent taste troubles.

The bacteriological results obtained during the period covered by the Report are set out in Table II.

"Bacteriologically, it would be difficult to improve on these results," is Sir Alexander's comment on these figures. The *raw* Thames water contained *B. coli* in 1 c.c. in 89·1 per cent. of the samples examined, while the finally treated water contained *no B. coli* in 100 c.c. in 95·5 per cent. of the samples submitted to examination.

The chemical results are shown in Table III.

The percentage reductions of B from A; C and D from B; and E from A from some of the figures are given in brackets. The striking reduction in the ammoniacal figures brought about by the primary filters is specially noticeable.

Section VI.—Resistance to Filtration.

The average resistance to filtration figures for the year 1930 are given in a Table in order of de-merit. They vary from 90 at the top to 321 at the bottom. "It is not, however," remarks Sir Alexander, "by averages alone that the subject should be considered. The times that really matter are when the water is almost unfilterable, when, for example, according to the laboratory tests, the return is nil." That occurred on no fewer than eighty-five occasions, but it should be remembered that the samples are only collected once a week. In the case of river waters, the bad filtration results are usually caused by floods, and the choking material is really mud, although in the spring the growth of diatoms may enter into the question. The same is true of the stored water when the storage is very slight, and the suspended matters in the river have not had time enough to settle. When storage is prolonged, however, the case is widely different, and the blocking effect is produced by growths, like *Asterionella*, *Fragilaria*, *Cyclotella*, &c.

Sections VII. to X.

The next two sections—VII., "Search for Pathogenic Microbes in Crude Sewage," and VIII., "A *Coli* cum *Streptococcus* Test for Waters"—deal with matters that are of concern rather to chemists and biologists than to engineers, and we pass them by with just a mention. Section IX. is devoted to some interesting "Meteorological Notes," and we learn that the year 1930 was "at all events, a comforting year from a waterworks point of view." The final section—No. X.—contains a series of "Miscellaneous" notes, which bear such titles as "Nothing New Under the Sun"; "Bird Life on the Board's Reservoirs"; "Kent Wells"; "Visitors, Health Weeks, &c."; "Excess Lime Method"; "Waltham Abbey Well"; "Copper and Health"; "Activated Carbon"; "Catadyn Sand"; and "Paratyphoid Fever at Barnes." Like everything else that Sir Alexander writes, they form most excellent and informative reading. Finally, there are the usual chemical and bacteriological Tables, &c.

The second part of the Report contains a description of the Board's Kempton Park Works, and with that we propose to deal in a future issue.

(To be continued.)

Table II.—*Walton—January to December* (*inclusive*), 1930: *Bacteriological Results.*

Description of sample.	Number of samples.	Average number of microbes per c.c. Agar at 37° C. (colonies counted after 20–24 hours.)	*B. coli* test (typical *B. coli*), percentage results.	
			Negative, 100 c.c. per cent.	Plus, 100 c.c. or less per cent.
River Thames raw water	249	358	0·0	99·9
Walton stored water	243	22	32·9	67·1
Mixed filtrates from one set of primary filters	247	34	30·0	69·9
Mixed filtrates from the other set of primary filters	247	43	27·9	72·0
Average results from secondary filters	988	7·7	70·8	29·1
Final filtrate from general filter well (chlorinated)	247	4·2	95·5	4·5

Table III.—*Walton—Chemical Results* (*Parts per* 100,000).

	Number of samples.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Chlorides expressed as chlorine.	Oxygen absorbed from permanganate, 3 h. at 80° F.	Colour m.m. brown, 2ft. tube.	Total hardness.	Permanent hardness.
A. Raw Thames river water	247	0·0072	0·0136	0·24	1·83	0·192	64	23·2	5·5
B. Walton stored water	52	0·0076 (incr.)	0·0126 (7·3)	0·24	1·83	0·143 (25·5)	41 (35·9)	22·1	5·5
C. Mixed filtrates from one set of primary filters	176	0·0014 (81·6)	0·0090 (28·6)	—	1·82	0·126 (11·9)	37 (9·7)	—	—
D. Mixed filtrates from the other set of primary filters	176	0·0018 (76·3)	0·0095 (24·6)	—	1·83	0·129 (9·8)	38 (7·3)	—	—
E. Final filtrate from the general filter well	194	0·0060*	0·0076 (44·1)	0·25	1·84	0·118 (38·5)	26 (59·4)	22·1	6·0

* This high figure was due to the artificial addition of ammonium sulphate, before chlorination, to prevent taste troubles.

FARADAY CELEBRATIONS.

As already announced, the Faraday Celebrations will take place in London from Saturday, September 19th, to Friday, September 25th. A reception room will be open at the Royal Institution, 21, Albemarle-street, W. 1, from 10 a.m. to 6 p.m. each day, and officers of the Royal Institution, with interpreters and guides will be in attendance. On Monday, September 21st, there is to be an informal meeting at 11.30 a.m. in the Lecture Theatre of the Royal Institution, when the programme will be explained in English, French, and German. From 3 to 4.30, also in the Lecture Theatre, the President and Managers of the Royal Institution will receive the delegates, and at 8 p.m. the Faraday Commemorative Meeting will take place at the Queen's Hall, Langham-place, W. 1. On Tuesday, September 22nd, the Institution of Electrical Engineers' Conference will be held at the Kingsway Hall, Kingsway, W.C. 2, at 10.30 a.m., and at 8.30 p.m. the Annual Conversazione of the same Institution will take place at the Royal Albert Hall. There will also be a Conversazione at the Royal Institution at the same time.

From 10 a.m. to 4 p.m. on Wednesday, September 23rd, delegates will be admitted to a private view of the Faraday Exhibition at the Royal Albert Hall, at 3 p.m. there will be a reception of the British Association delegates, and at 4.30 the Faraday Exhibition will be opened to the public by the President of the British Association, the Right Hon. J. C. Smuts, C.H., F.R.S., who will deliver his Presidential Address at 9 p.m. at the Central Hall, Westminster, S.W. 1.

On Thursday, September 24th, Sir Joseph Petavel, K.B.E., F.R.S., the director, will hold a garden party at the National Physical Laboratory, Teddington, from 3 to 6 p.m., whilst at 8.30 p.m. a soiree will take place at Burlington House, Piccadilly, W. 1, at the invitation of the President and Council of the Royal Society.

On Friday evening, September 25th, at 7.15 for 7.45, his Majesty's Government will entertain representative delegates and guests to dinner at the Dorchester Hotel, Park-lane, W. 1, when the Prime Minister hopes to preside.

Apart from these arrangements, visits to places of interest in London and the surrounding country will be paid.

Registration forms for the Celebrations should be completed and sent to the general secretary, Royal Institution, 21, Albemarle-street, London, W. 1, before September 1st.

THE GRAMPIAN HYDRO-ELECTRIC POWER SCHEME

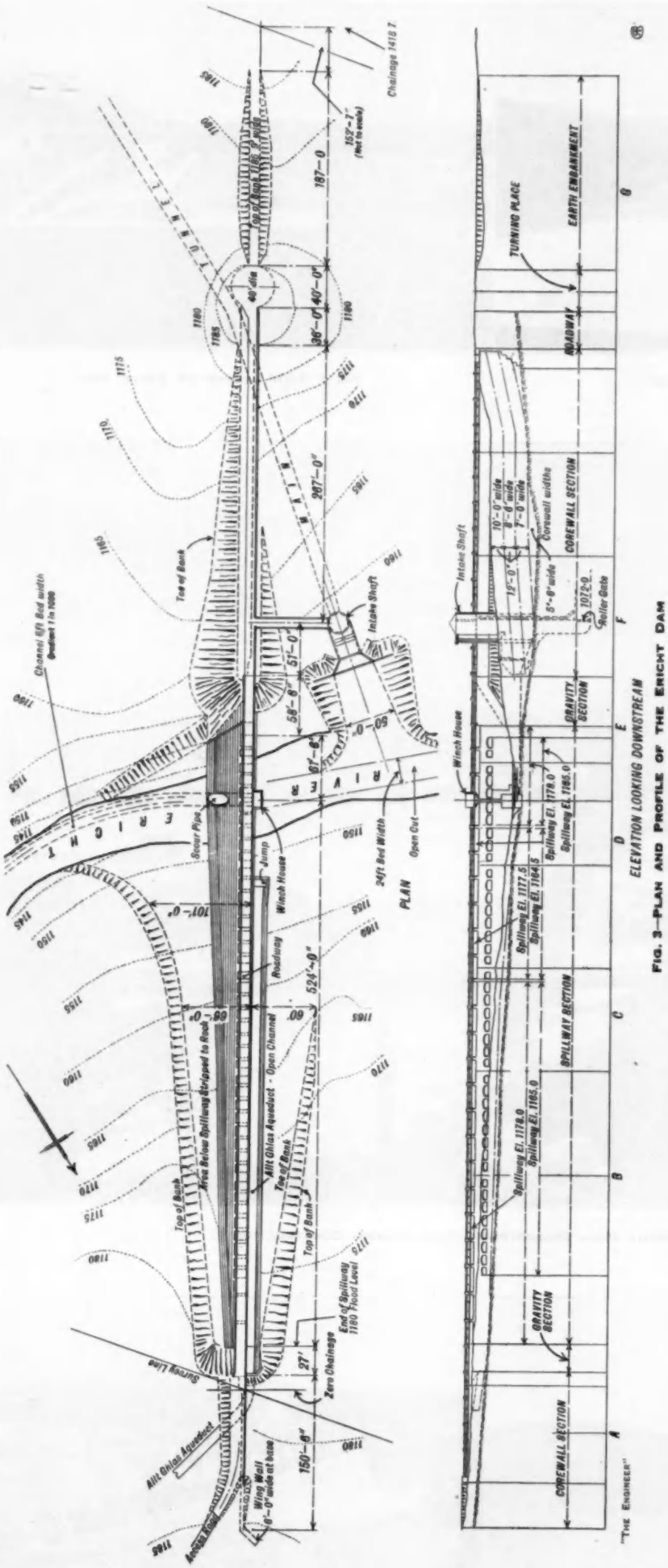

FIG. 3—PLAN AND PROFILE OF THE ERICHT DAM

The Grampian Hydro-Electric Power Scheme.

No. II.*

TRUIM DIVERSION.

WE are now in a position to give fuller particulars of that portion of the scheme which is actually in operation, and it will be convenient to start at the furthest point away from the power-house, that is to say, with the works by which the flood waters of the River Truim are diverted into Loch Ericht. A masonry gravity dam 229ft. long—see Fig. 4, page 166—with a core wall structure on the east bank 290ft. long, was built across the stream at a point nearly a mile upstream from the village of Dalwhinnie. At one end of the dam is the intake furnished with grid screens to arrest floating obstructions, and with an intake sluice measuring 7ft. by 6ft. In the river part of the dam there is a scour sluice measuring 5ft. by 6ft. As the Truim is a stream up which salmon mount beyond the point chosen for the dam, a fish ladder, having five pools, was provided—see Fig. 5, page 166. The floating weir, which is at the entrance to the fish ladder, is designed to pass automatically the compensation water at times of flood, all the flow above 24 cusecs being diverted into Loch Ericht, while the sill of the diversion weir at the intake is at such a height that, in times of low water, all the flow will pass down through the floating weir and down the fish ladder. The aqueduct below the dam consists of reinforced concrete pipes 6ft. in diameter and is 2440ft. long. Its route is not quite straight, as may be seen from the small inset drawing at the left top corner of Fig. 2 *ante*, and on its way it passes under a public road and under the Highland line of the L.M.S. Railway. Provision has been made, where it crosses under the railway, for another pipe to take, at some future time, the waters of Loch Cuaich, as mentioned in our first article; but, beyond that point, the gradient of the aqueduct is increased and one 6ft. pipe can take both the present and the future flows. A junction box has been provided for that future connection. The outlet at the end of the aqueduct has been specially designed to destroy the velocity of the water as it is discharged, and to release it at low velocity into Loch Ericht. The maximum top water level in the loch in the present development comes within 30 or 40 yards of the end of the aqueduct and the water flows into the loch.

The original maximum water level of Loch Ericht was at 1153ft. above O.D. For the present development of the scheme it was necessary to raise that maximum level by 12ft. to 1165ft. above O.D., and to do that, a dam has, as already mentioned, been built across the River Ericht by which the waters of the Loch originally made their egress. Loch Ericht is a narrow piece of water extending about 14 miles long in a north-easterly direction with a maximum width of about a mile. The available storage, with a top water level of 1153 O.D., was 994 millions of cubic feet, and at the raised level of 1165 O.D. the available storage is increased to 3425 millions of cubic feet. The minimum level down to which the loch will be lowered under the present development is 1148ft. O.D.

ERICHT DAM.

A good deal of investigation was necessary before the most advantageous place to construct the dam was decided upon, trial pits having to be sunk over a wide area. These trial pits revealed that over practically the whole area there was a layer of peat varying in depth up to some 14ft. Generally speaking, there was, below the peat, a stratum of clayey or sandy gravel, which varied very considerably in thickness in different areas, while in some areas, boulders were encountered. Below the gravel there was, generally, a small amount of broken rock before a solid rock foundation was reached, while in one place, immediately beneath the intake shaft, there was a depth of 5ft. of very fine clay between the sandy gravel and the rock. The amount and character of the overburden varied considerably. On the line finally chosen for the dam, the overburden on the east side varied from about 8ft. to 14ft., while on the west side it was as much as 45ft. This variation in the quantity of the overburden led the designers of the dam to decide—as a solid concrete dam was necessary at the spillway—that that portion should be kept

TABLE.

Pit.	Ground elevation.	Rock elevation.	Materials encountered.
A	1185·51	1173·51	—
B	1171·74	1157·74	—
C	1160·80	1152·80	3ft. 9in. peat; 3ft. 9in. clayey gravel; 6in. broken rock.
D	1148·70	1139·20	3ft. peat; 4ft. sandy gravel; 2ft. 6in. broken rock.
E	1150·00	1135·50	4ft. peat; 10ft. 6in. sandy gravel.
F	1158·73	1125·73	4ft. peat; 24ft. sandy gravel and boulders; 5ft. very fine clay.
G	1178·42	1163·42	4ft. peat; 11ft. sand; gravel and boulders.

towards the east bank, and that towards the west bank the section of the dam should be changed to a

* No. I. appeared August 7th.

THE GRAMPIAN HYDRO-ELECTRIC POWER SCHEME

BALFOUR, BEATTY AND CO., LTD., LONDON, ENGINEERS AND CONTRACTORS

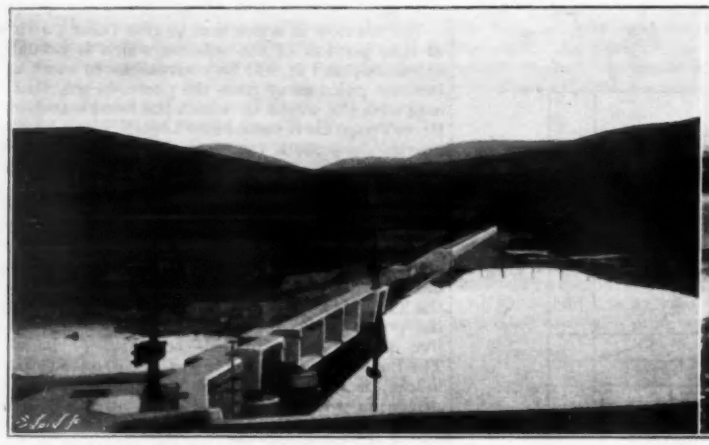

FIG. 4—DAM ON RIVER TRUIM

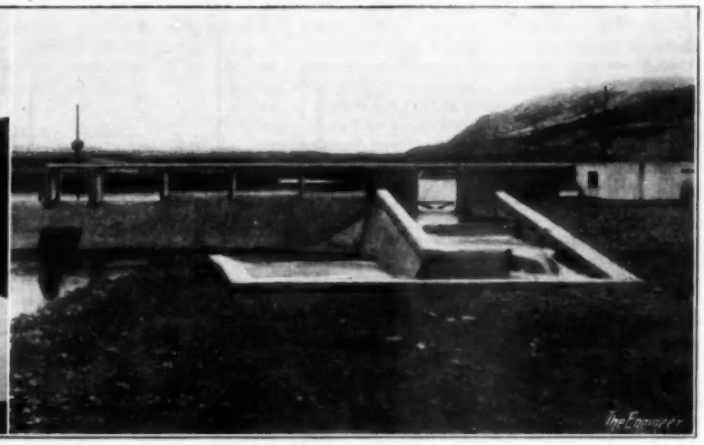

FIG. 5—FISH LADDER AT TRUIM DAM

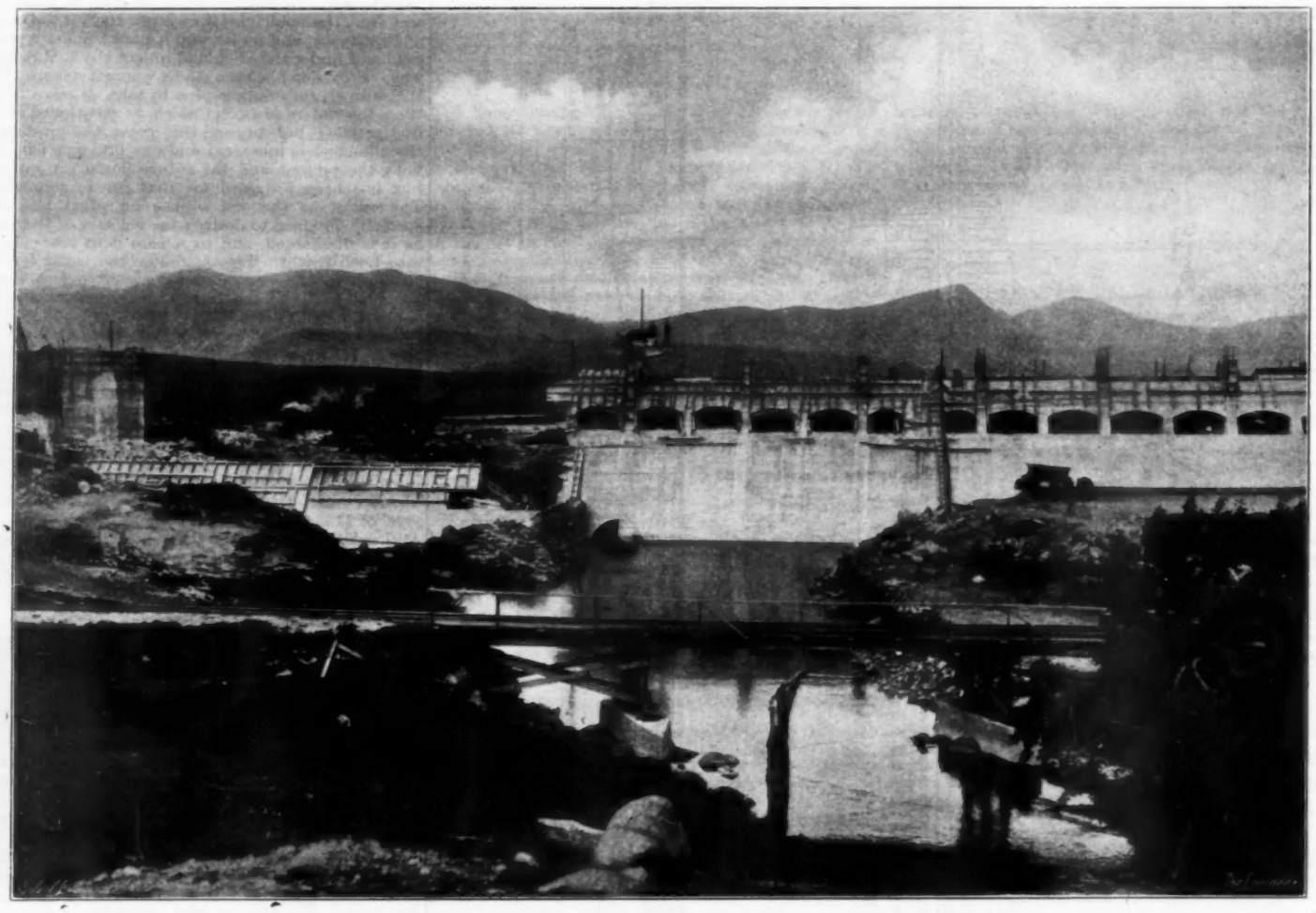

FIG. 6—ERICHT DAM, DOWNSTREAM FACE, DURING CONSTRUCTION

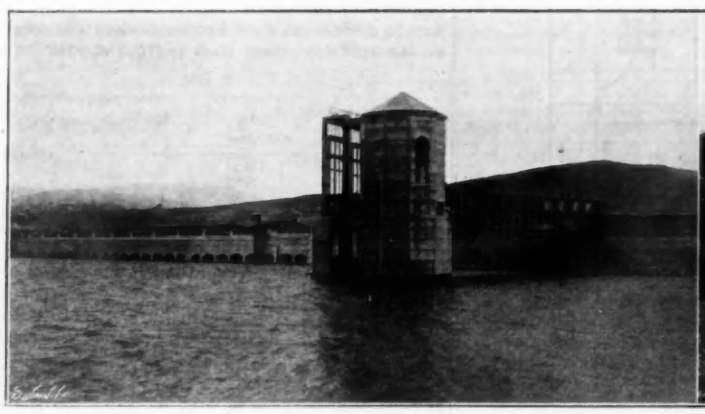

FIG. 7—ERICHT DAM, UPSTREAM FACE AND INLET TOWER

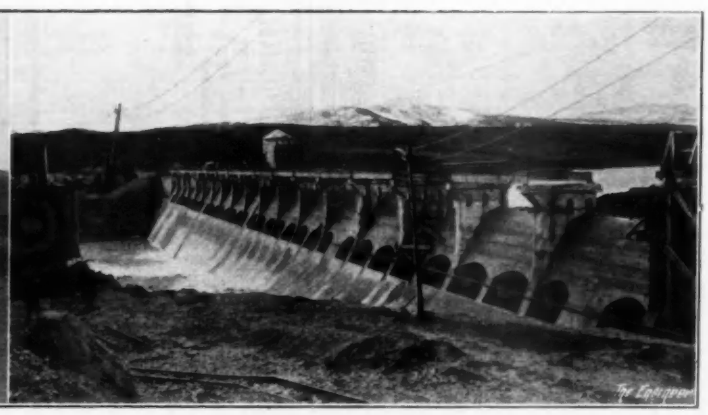

FIG. 8—ERICHT DAM, VIEW ALONG DOWNSTREAM FACE

core wall with an earth embankment behind it, to reduce the amount of excavation and concrete work. A dam with an overall length including approaches of 1402ft. 6in. was found necessary. The greatest depth to which excavation below the original ground line was carried was 45ft.

It will be of interest, perhaps, if we give in greater detail, the results obtained from seven pits sunk on the line of the dam. The points chosen are indicated by the letters A to G inclusive, on the profile in Fig. 3, while the materials encountered, with their thickness, are set out in the table above with the ground and rock levels.

The dam rises to a height of 45ft. above the bed of the river, and 58ft. above the lowest foundation level. The foundations are built on hard granite and on both the dam and the core wall are well keyed into it, as shown on the cross sections of the dam.

A plan and profile of the dam is seen in Fig. 3, and typical cross sections of the spillway and other sections are given in Fig. 9, while half-tone engravings of the structure are given on pages 166 and 170. On the left, or east side, there is a core-wall section with a length of 150ft. 6in. followed by 671ft. of gravity type concrete dam, the majority of which is taken up by the spillway, and then 318ft. of core-wall section. Beyond this is a short length where the original ground will come above the highest flood level when the scheme is fully carried out, and across a shallow depression there is a length of 187ft. of earth embankment.

There are in the dam two lines of spillway openings at different levels; the lower line of these openings is for the present development, and they will be blocked up when the second portion of the scheme is in operation and the water level of Loch Ericht is raised. In the lower line, there are forty-two openings, thirty-one of which are 10ft. 6in. wide, while eleven are 7ft. 6in. wide. The total combined width of all these openings is 408ft. The sills of thirty of the openings are formed at an elevation of 1165·0ft. O.D., while the sills of the remaining twelve are at an elevation of 1164·5 O.D. These openings are rectangular at the bottom and have arched soffits. There are, in all, twenty-four spillway openings in the upper line, the sills of eighteen of them are at 1178·00 O.D., while the remaining six are at 1177·50 O.D. These openings are all rectangular, and are all 23ft. wide, giving a total width of opening of 552ft. These upper openings have been formed in the dam as built, but they will not come into service until the further development of the scheme.

A level roadway 8ft. wide between curbs and furnished with hand rails has been formed, as a bridge, above the spillway at an elevation of 1183·00 O.D., or 3ft. above the flood level to be anticipated when the full scheme is completed. This roadway traverses the whole length of the concrete portion of the dam, and is continued, on both sides, along the core wall sections. Seven contraction joints have been provided in the length of the bridge, in each case the joint comes in a pier separating two spillway openings. These joints of copper plate and asphalt plug seals are of the form shown in Fig. 9.

The greater length of core-wall section comes on the west side of the river, or on the right-hand side in the drawing—Fig. 3. The concrete core wall has a width, at its greatest depth, of 5ft. 6in. Above that point, for a depth of 12ft. the width is 7ft., while for another 12ft. it is 8ft. 6in. wide, and for still another 12ft. it is 10ft. wide, the greatest depth of concrete in the wall being nearly 50ft. The excavation for the core-wall sections was done between vertical sheeting which was driven through glacial moraine of a fine sandy nature with occasional boulders. Derrick cranes were used at both ends of the dam to dispose of the excavated materials and to place the concrete. The concrete used in the mass of the dam was a mixture of 1 : 3 : 6, with plums, while the mixture used for a thickness of 2ft. in the upstream face was 1 : 2 : 4. The concrete used in the core wall was a mixture of 1 : 3 : 6. The concrete, both in the dam and in the core wall, was placed by means of an electrically-operated overhead cableway.

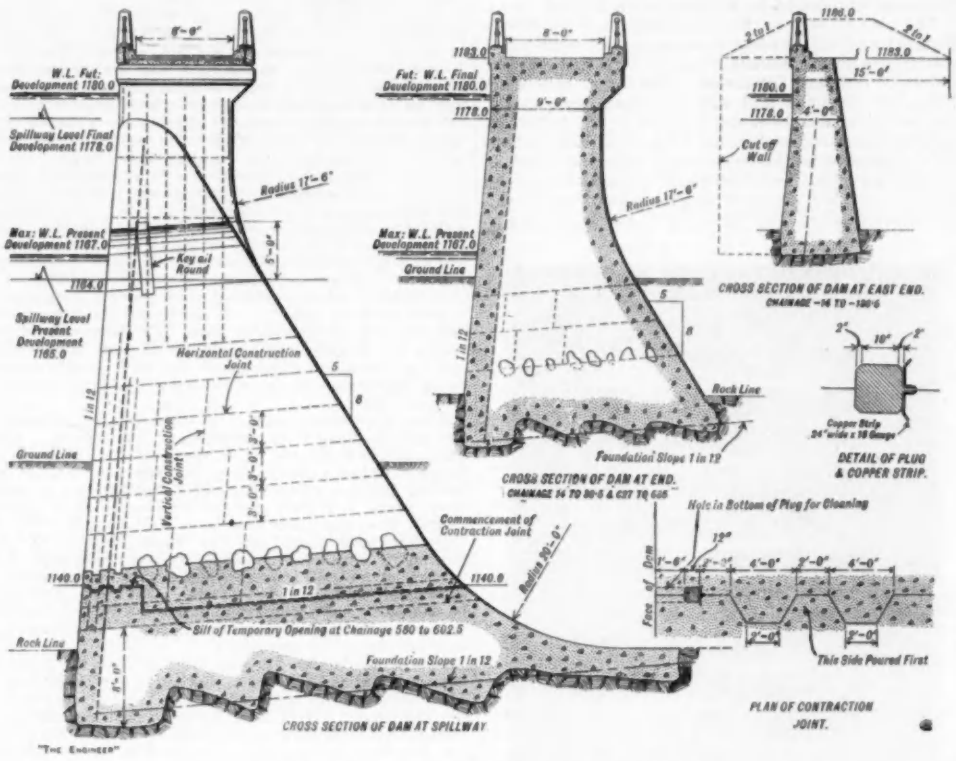
W.L. Fut: Development 1180·0
Spillway Level Final Development 1178·0
Radius 17'-6"
Max: W.L. Present Development 1167·0
Key all Round
Spillway Level Present Development 1165·0
Horizontal Construction Joint
Ground Line
Vertical Construction Joint
Commencement of Contraction Joint
Radius 90'-0"
Silt of Temporary Opening at Chainage 580 to 602·5
Rock Line
Foundation Slope 1 in 12
CROSS SECTION OF DAM AT SPILLWAY
Fut: W.L. Final Development 1180·0
Foundation Slope 1 in 12
CROSS SECTION OF DAM AT END.
CHAINAGE 14 TO 80·5 & 627 TO 695
CROSS SECTION OF DAM AT EAST END.
CHAINAGE -14 TO -120·5
Cut off Wall
Copper Strip 24" wide x 16 Gauge
DETAIL OF PLUG & COPPER STRIP.
Holes in Bottom of Plug for Cleaning
Face of Dam
This Side Poured First
PLAN OF CONTRACTION JOINT.
"The Engineer"

FIG. 9—TYPICAL CROSS SECTIONS OF ERICHT DAM

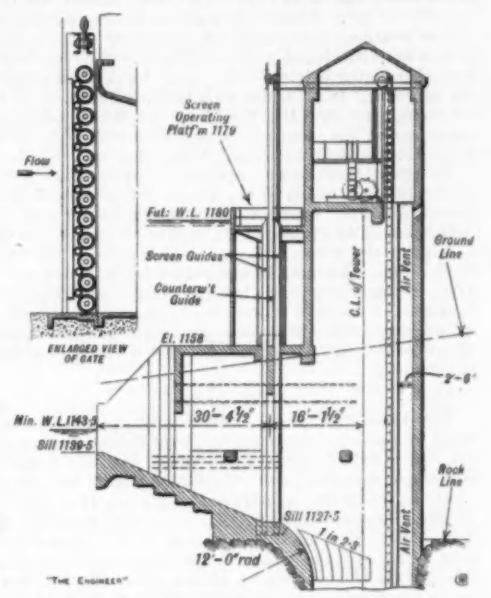

FIG. 11—SECTIONS OF INLET TOWER AND EMERGENCY GATE

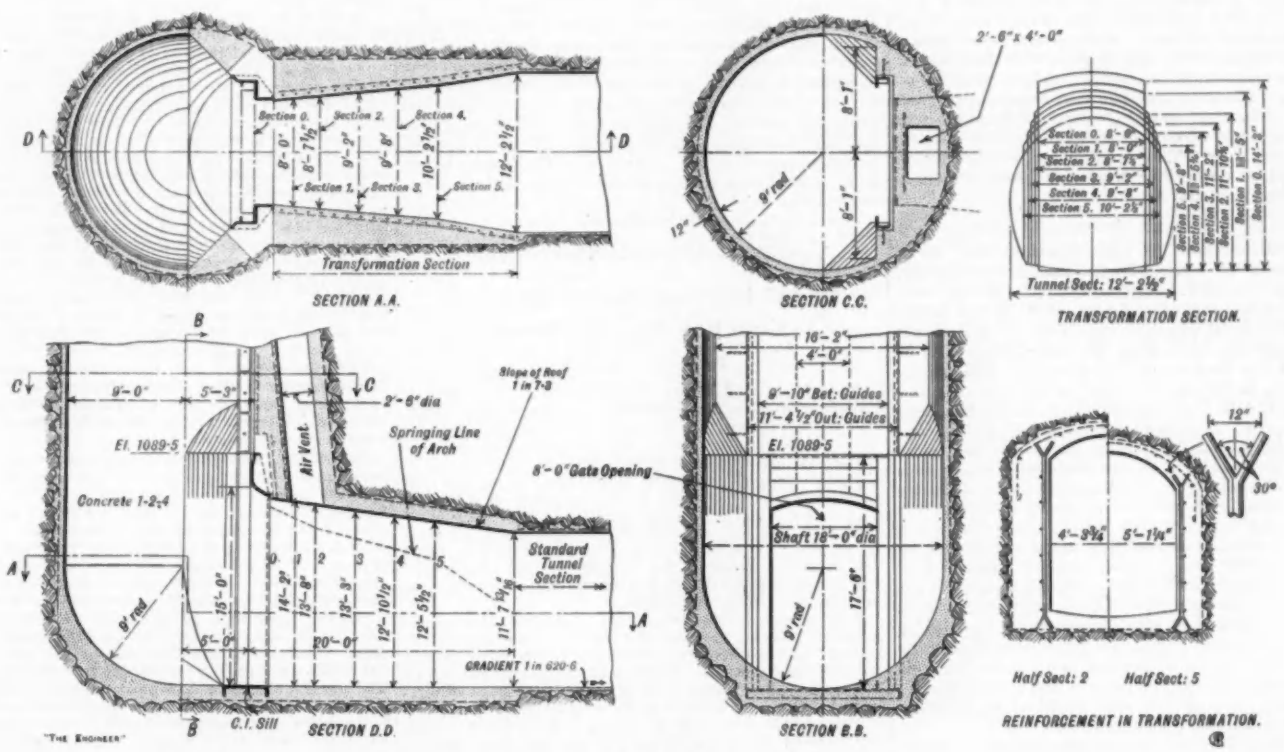

FIG. 10—ARRANGEMENTS AT FOOT OF INLET TOWER

This cableway, which was electrically-driven and had a clear span of 1200ft., was supplied by J. M. Henderson and Co., Ltd., of Aberdeen, and was capable of dealing with gross loads up to 2½ tons. It was operated by an enclosed-ventilated slip-ring rotor reversing induction motor, designed to develop 75 B.H.P. on a 440-volt, 50-cycle, three-phase supply. The hoisting speed was 300ft. per minute, and the travelling speed of the load 1200ft. per minute.

For crushing the rock for use as aggregate, a 25in. by 12in. Blake stone breaker with manganese steel jaws was employed. It was supplied by Robert Broadbent and Son, Ltd., and was driven by an electric motor. Messrs. Broadbent also provided a set of crushing rolls, 24in. diameter by 24in. wide, which were furnished with steel shells. This machine was also motor driven. The same firm also supplied an elevator, 16in. wide with 49ft. centres, and a revolving screen 14ft. 6in. long by 4ft. diameter, made up of ¼in. steel plates punched with 1¼in. and 2¼in. holes, as well as several shoots, &c.

At a point in the dam—approximately in the centre of the original width of the River Ericht—there is a scour pipe, 12ft. in diameter, with its inlet invert at an elevation of 1136ft. O.D., and at the inlet end of this pipe the river bed was deepened to 1135·0ft. O.D. The inlet end is controlled by a sluice gate 10ft. square, supplied by Ransomes and Rapier, operated by a petrol winch contained in a small house at roadway level. This scour pipe was used for taking the flow of the River while the dam was being constructed.

Open Cut.

The Open Cut from Loch Ericht to the Ericht Dam follows the course of the River Ericht, except in the upper half near the Loch, where the direct route was taken into the Loch; the River Ericht being too tortuous to follow. The Open Cut has a bottom width of 24ft., and is nearly 7000ft. long on a gradient of 1 in 1500. The maximum depth of the excavation was 17ft., and the channel has been made of such dimensions that it will be able to pass the full flow when the scheme has been carried out in its entirety. The material excavated in the cut consisted of peat and sandy marl in the upper—or Loch—half, and of boulders and sandy material in the lower half of its length. The upper end of the cut and the deepening inside Loch Ericht were effected by means of an 8in. sand and gravel pump, mounted on a pontoon—similar to those used in Thames ballast pits—but the main part of the excavation was done by a 1 cubic yard Ransome-Rapier-Marion dragline with a 50ft. boom. This machine worked very satisfactorily in the softer materials, but the progress was slower when boulders embedded in clay pockets were encountered.

The pontoon, for the dredging operation, which was built of mild steel, ⅜in. thick and measured 24ft. long by 14ft. wide and 5ft. 6in. deep, was supplied by Gwynnes Pumps, Ltd., of Hammersmith and Lincoln. It was equipped with an "Invincible" full-way type gravel pump, with an 8in. bore, driven by a three-phase, 440-volt, 50-cycle induction motor designed to develop 145 B.H.P. when running at 733 r.p.m. The pump motor was controlled by an Ellison oil-immersed stator switch. The plant was designed to remove from 40 to 54 tons of free-running material per hour. The dragline excavator, which was carried on caterpillar trucks and had a 1 cubic yard bucket, was coal fired.

Intake Tower.

The arrangements for withdrawing the water from the reservoir formed by the dam are of interest. The bed of the 24ft. dredged channel leading from the Loch to the dam is 1137·5ft. O.D. at the intake shaft. A channel tapering from 50ft. to 40ft. leads to an intake sill 40ft. wide at 1139·50ft. O.D., or 2ft. above the bottom of the channel. The intake shaft, which is 18ft. in diameter, is sunk in rock to a level of 1072·0ft. O.D.—or 65ft. 6in. below the floor of the channel. It is lined with concrete and is constructed above rock level in a concrete tower taken up above the roadway on the dam, with which it is connected by means of a steel girder access bridge 8ft. clear width and 70ft. span. From the beginning of the intake works to the intake shaft the water channel is roofed over and the water will always be drawn off below the surface to stop surface drift wood from reaching the two screens guarding the intake, which are each in duplicate and measure 20ft. by 20ft. These screens may be raised and lowered by hand-operated gear, carried on framework above the screen guides, the arrangements being such that one screen of each pair may be down while the other is up for cleaning. The screens were supplied by Glenfield and Kennedy, Ltd., of Kilmarnock.

Immediately beyond the screens the water enters the intake shaft and flows down vertically for a distance of 50ft. to the bottom of the shaft, where it enters the tunnel through a specially designed emergency gate, 15ft. high and 8ft. wide. This gate was supplied by Glenfield and Kennedy, Ltd., of Kilmarnock, and is one of the outstanding features of the inlet arrangements. Ordinarily, it will be hung clear of the tunnel inlet, but should occasion arise when it is necessary to prevent the water flowing from the Loch into the tunnel, the gate will, when a releasing lever is freed, descend by its own weight and close the inlet to the tunnel. We had occasion to traverse the tunnel in its dewatered state, and were able to observe the amount of water which this gate allowed to pass. How much that was may be gauged from a glance at Fig. 12, which is reproduced from a photograph taken of the gate when it was holding up the water under what was, practically, full operating head. The amount of water passed was only sufficient to represent a depth of flow of a few inches of water in the tunnel, or not enough to interfere with workmen who might be working in the tunnel.

The gate, as seen in the accompanying illustrations, Figs. 11 and 12, consists of a framework built up of steel joists and channels, housing two sets of steel rollers of different diameters. The larger rollers are 14½in. in diameter and are arranged, horizontally, and at 15½in. centres apart, and are rigidly bolted by means of screwed stub axles formed at their ends to two vertical steel joints. These rollers are not in contact with one another, their surfaces being 1in. apart. Another series of smaller steel rollers, 4in. in diameter, which are "floating" rollers, are free to

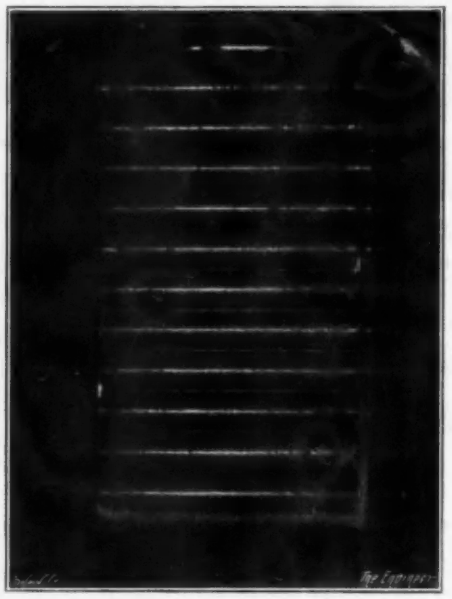

FIG. 12—EMERGENCY GATE UNDER HEAD OF WATER

take up their seating on the larger rollers, and are not bolted at their ends, being only prevented from coming adrift by the flanges of the vertical joists. The construction will be readily understood by reference to the drawing, Fig. 11. The gate is arranged with the smaller rollers facing upstream, and, when the gate descends, the pressure of the water forces the free smaller rollers into the curved spaces between the fixed larger rotating rollers, with the result that the flow of water into the tunnel is effectively arrested as explained above. This gate is free to fall in its guides by its own weight, but for raising it there is a small petrol engine which is contained in the intake tower at a level above that reached by the highest flood water.

(To be continued.)

Repairing All-Metal Railway Coaches by Welding.

By A. J. T. EYLES.

As is fairly well known, the bodies of modern railway passenger coaches are constructed entirely from metal, and much progress has been made during the last few years in the application of the oxy-acetylene flame in the repair of damaged metal panelled coaches.

Recent progress made by manufacturers of all-metal railway passenger coaches in the processes of stamping or pressing and welding metals would appear to suggest that their product as material is easier to repair than to replace. It is also stressed, that new service parts are seldom necessary, for modern welding operations can be speedily applied in the repairing of fractures, torn or ruptured panels and dents.

For a permanent repair on damaged aluminium-panelled railway coaches, the writer is strongly of the opinion that oxy-acetylene welding is decidedly preferable to any other method. In fact, nothing in aluminium or aluminium alloy repair work is beyond the scope of oxy-acetylene welding when it is done by competent welders.

Much has been written during the last few years regarding various electric welding systems and their spheres of applicability, but in aluminium welding technique, the best results, both in production and repair work, have invariably been obtained by employing the oxy-acetylene process. When work is suitable for electric welding, welds can be made with greater rapidity than by the oxy-acetylene method of welding; but that cannot be said with regard to the welding of aluminium, or even aluminium alloys, although, during the last few years, the application of the electric arc and spot welding of aluminium has made much progress.

Aluminium welding with the oxy-acetylene blow-pipe is not difficult, but it requires a special technique and careful manipulation. The blow-pipe used should be designed to give a flame which permits intensely localised heating. The tip should be one size larger than that used for steel. A strictly neutral flame is necessary as it gives the best speed and economy.

In welding repairs on aluminium coach bodies the use of a good flux is an important factor, as it performs the function of dissolving and deoxidising the oxide layer formed and protects the metal from further oxidation during the welding operation. Aluminium welding fluxes should be used sparingly and, therefore, should not be thrown on the weld joint in excess, as is sometimes done when brazing copper or brass.

Various methods of applying aluminium fluxes are practised. Probably the best method is to use them in the form of a varnish on the welding rod. The latter is heated at one end and dipped into the powder flux, which readily adheres to it. A good method of applying flux on thin aluminium sections where welding rod is not used is to paint a paste of the flux along the flanged edges, which are prepared for the welding operation. Liquid or paste aluminium welding fluxes can be reduced to their correct flowing consistency by mixing with clean water. It is generally unnecessary to apply any additional flux when using a flux-coated welding rod, for the gradual melting up of the rod as the weld proceeds will automatically feed flux on the weld joint just where it is required and at a uniform rate. In other words, the flux will flow ahead of the flame and prepare the metal for welding.

In order to obtain welds of satisfactory homogeneity, a good grade of welding rod for repairs to aluminium-panelled coaches should be used. For pure aluminium panels the welding rod should be of pure aluminium, and for aluminium alloy panels the welding rods should be of approximately the same composition as the alloy to be welded.

Sheet aluminium panels less than ⅛in. in thickness are usually flanged in preparation for welding. The flange being about the same height as the thickness of the sheet or just a little higher. The weld joint is made by holding the two upstanding edges together and melting them down. For such work no welding rod is required.

After the aluminium has been welded it is essential that the weld joint and the surrounding metal be thoroughly cleaned by washing and brushing with hot water to remove all traces of the flux, thereby preventing subsequent corrosion of the metal. The weld joint may be cleaned by impinging a steam jet on it. When available the steam jet method has advantages for removing the corrosive flux from corners, &c.

In a particular case the side panel of a coach was badly damaged and severely torn. Owing to the buckled and distorted condition of the aluminium panel, it was necessary to remove the interior panelling near the damaged area so that tools could be conveniently used to straighten out the dents in the panel. The torn or ripped portion was then cut away and a rectangular piece of sheet aluminium of the required thickness and dimensions was fitted to the cut edges in the panel. The aluminium patch was first tack welded at intervals of 3in. to 4in. around the edges to keep it in position during the welding operation, and afterwards strongly welded with the oxy-acetylene blow-pipe flame. The weld joints were well built up with pure aluminium rod. The excess deposit of metal at the weld was speedily removed by grinding with an electric portable grinder. Careful hammering of the welded areas gave the weld a neat and finished appearance, and when the coach had been treated with the usual coats of paint and varnish the welded joints were practically invisible.

Another job was that of a damaged all-steel coach, the steel panelling of which was 0·080in. thick. In this case the damaged portion of the panelling was cut out by means of the oxy-acetylene blow-pipe. Although similar repairs to steel-panelled coaches can be readily effected by arc welding, the writer is of the opinion that when the steel panels are less than ⅛in. in thickness the oxy-acetylene blow-pipe method is decidedly preferable. After the damaged part had been removed and the near areas straightened, a rectangular piece of sheet steel of the required thickness and dimensions was cut and bent to the desired curvature, the steel patch being cut about ⅛in. less in width and length than the hole in the panelling. Tack welds were made at intervals of 4in. to 5in. around the edges, then strongly welded by the oxy-acetylene blow-pipe flame, the weld being well built up with mild steel rod. After the steel patch had been welded the weld joints were hammered to correct the contours. The excess weld metal was subsequently removed by the aid of an electric portable grinder.

Experience proves that when welding repairs of this kind are properly done, the repaired portion will be fully as strong as the steel panel itself, and if methodically done the weld joints will not be discernible from the original body finish and curvature.

In addition to welding repairs on all-metal railway coach side and end panels, damaged roof canopies, side and end doors, roof panelling, commode hand rails, door handles, locks, net rod brackets, and other component parts, are often repaired by modern welding methods.

In the art of straightening out or removing dents from damaged all-metal coach panels, it is good practice to anneal the metal in the immediate vicinity of the damaged part with the blow-pipe flame in order to minimise any possibility of cracking, particularly when a sharp V-shaped dent has to be dealt with, the metal just escaping perforation. The force of the blow that caused the sharp dent hardened the metal at that point probably too much to withstand any more bumping or hammering without softening. When correctly done, persistent and judicious hammering over suitable shaped tools—dolly blocks—will force the dent out until the original shape is restored. Experience shows that it is very much better to deliver twenty to thirty blows to remove a fairly large size dent in metal panelling than two or three sharp and heavy ones, whereby the metal is likely to become stretched. Care should also be taken to prevent damage to the metal panel surface by producing "crescents" in the panelling caused by using the edge of the hammer. Buckles, distortions and looseness in metal panelling can only be corrected by judiciously hammering the area, or surfaces, which are tight, leaving the "loose" areas untouched.

In conclusion, the author wishes to acknowledge his indebtedness to Mr. E. J. H. Lemon, chief mechanical engineer, London, Midland and Scottish Railway, for assistance given.

Railway and Road Matters.

ANSWERING a question on July 28th, Mr. Morrison said that he had asked the British railway companies that had made experiments with the oil-electric system of traction for a report as to the results.

THE Railway and Canal Commission on July 23rd rescinded the Order of February 25th, 1891, as to the Cheshire Lines Committee being compelled to keep its Winsford branch open for passenger traffic despite the loss of traffic.

THE London Passenger Transport Bill has so far been under the consideration of a joint Select Committee of both Houses. Those proceedings were concluded on July 30th, and the next stage will be before a Committee of the whole of the House of Commons on October 20th.

THE Simla correspondent of *The Times*, cabling under date of August 5th, states that the State Railways' receipts from April 1st to July 18th were 333 lakhs of rupees (nearly £2,500,000) less than in the corresponding period of 1930, and 452 lakhs (£3,400,000) less than in 1929.

DURING the Bank Holiday week-end the main line railways carried well over 10,000,000 passengers without a single person being killed or injured. In 1930 only one passenger lost his life in an accident on the railways, although 1,218,000,000 passengers were carried, and 424,000,000 train-miles were run.

THE assistance rendered by the railway companies to the iron and steel trades by the increased purchase of materials is indicated by the fact that the Great Western during last year spent £599,222 on renewals of the track and relaid 326 miles, as compared with an expenditure of £408,726 and 216¼ miles relaid in 1927. The London, Midland and Scottish spent £981,340 on renewals, as against £792,714 in 1927 and relaid 555 miles as compared with 431¼ miles.

THE provision by the London and North-Eastern Railway of two more running lines, making four in all, between Romford and Gidea Park, was mentioned in our Annual Article "Railway Engineering in 1930," on January 16th last. That work, which is now nearly completed, is to be extended by further duplication up to the junction with the Southend line at Shenfield Junction, a distance of 6 miles. This development will necessitate the alteration and improvement of the stations at Harold Wood, Brentwood, and Shenfield, and the line to Southend will be carried under the main line by a burrowing junction, so that trains to Southend will not cross the path of trains on the up main line.

IN the *London and North-Eastern Railway Magazine* for July a description was published of the new locomotive depôt that is being provided by the company at Frodingham. It is to replace that at Keadby and so save considerable light running, as the engines working trains from and to Frodingham have had to be stationed at Keadby. The new depôt will have charge of about forty locomotives, and the shed, measuring 250ft. by 75ft., will provide accommodation for twenty. There will be a small mechanical coaling plant, an engine turntable of 70ft. diameter, and a hot-water washing-out plant. Hitherto there has been considerable trouble with boiler and fire-bar repairs, because of the water supply being of an unsatisfactory nature. That is to be remedied by a supply of better quality from the works of the North Lincolnshire Ironstone Company.

THE Ministry of Transport railway statistics for May have recently been issued as a Stationery Office publication, price 2s. 6d. In making any comparison with the corresponding figures for May, 1930, it must be remembered that the present figures include Whit-week, which in 1930 fell in June. The statistics show that, evidently because of the circumstances just named, the number of passenger journeys was only 0·5 per cent. less than in May, 1930, whilst the receipts from passengers increased by 5·8 per cent. Coaching train miles were reduced by 1·3 per cent. Because, no doubt, of the Whitsuntide holidays, combined with bad trade, the tonnage of freight was down by 20·1 per cent. and the receipts therefrom by 18·6 per cent. The freight train mileage was reduced by 14·4 per cent. The average train load of the freight trains decreased from 124½ to 122 tons, and the net ton-miles per engine hour from 455½ to 448¼.

IN our Annual Articles reviewing Railway Engineering during 1929 and 1930 mention was made, under the heading of the Great Western, of the cementation work done, under schemes prepared by Mr. Raymond Carpmael, the company's chief engineer, in the Severn Tunnel. That work has now been the subject of an article by Mr. Carpmael in the August issue of the *Great Western Railway Magazine*, which has been made of additional interest by the reproduction of a plan of the tunnel and some photographs. The length that required treatment was from the Bristol mouth of the tunnel at 11 miles 0 chains to 12 miles 5 chains. At the latter point the geological section indicated the termination of the gravel and marl and the commencement of a bed of sandstone and pennant rock. As a first step the half-mile between 11 miles 30 chains to 11 miles 70 chains was dealt with. Owing to the decreased use of the tunnel by trains in the winter months, traffic conditions called for the work to be done then, and it was begun on November 3rd, 1929, and concluded on April 13th, 1930. The undertaking required the drilling of 2123 holes, with a total footage of 9503ft.; cement was injected into 1830 holes, and the amount used was 3016 tons, averaging 1·16 tons per lineal foot of tunnel. The work proved to be so successful that it was decided to complete the remainder. That stage was begun on November 2nd, 1930, and completed on May 3rd last. It increased the number of holes to 4233 and the footage to 21,683 lineal feet, whilst the cement injected was 8132 tons, averaging 1·48 tons per lineal foot of tunnel. The Sea Wall ventilating shaft on the Bristol side and the Sudbrook on the South Wales side were also similarly strengthened. The contractors were the François Cementation Company, and Mr. Carpmael concludes his article by observing that the whole of the work was carried out in a very methodical manner and without accident, a result which reflects great credit on all concerned.

Notes and Memoranda.

AN American firm has, according to *Steel*, discovered a satisfactory method of making crank shafts in cast steel. The process is said to involve a complicated triple heat treatment.

IN the vestibule of the Science Museum, South Kensington, an exhibition has been opened to show the development of the modern ship from the primitive log upon which the savage lay or straddled.

A PRESSED steel tank, which, it is claimed, will be the largest in the world, is to be erected at Dunga Gali in the Punjab. It will be 204ft. long, 160ft. wide by 16ft. deep, and will hold 3½ million gallons of water. It is being supplied by Braithwaite and Co., Ltd.

RECENTLY, a party of motorists, who were near Juba, in Central Africa, were stranded by a breakdown. They cabled to England for a spare part. The manufacturers delivered the part to the Croydon aerodrome in 15 hours. It was put aboard the outgoing liner of Imperial Airways, and was delivered at Juba, 5000 miles away, within seven days of the dispatch of the cable.

As a result of research work by the Industrial Research Laboratory, Department of Industries, Bengal, articles which have been made for generations with metal composed of about 77 per cent. copper and 23 per cent. tin, can now be turned out at 50 per cent. less cost, as well as being lighter and better, by the inclusion of a certain proportion of zinc and a trace of aluminium when the alloy is being melted in the crucible.

IN the July issue of the *Worcester Polytechnic*, Massachusetts, there is a brief reference to some experiments which have been made at the Institution's hydraulic laboratory on a tunnel model that was built and tested to determine the effect of air being introduced under pressure to keep the water surface free from the rough top surface of the tunnel, in order to increase the discharge of an unlined tunnel. The results of the investigation are not, however, disclosed.

A SIMPLE method of truing up the bore of some cast iron pipes, 11ft. 10in. in length and of from 22in. to 30in. in diameter, was devised by the American Cast Iron Pipe Company, and is described by Mr. D. S. Moxley in the *Engineering News-Record*. Round a 10in. joist there was cast a mixture of cement and broken-up carborundum wheels. This grinder was reciprocated inside the pipe by a 15 H.P. motor, while the pipe was slowly rotated by hand. As much as $^{1}/_{16}$in. of metal was taken off in five hours, the accuracy of the bore was $^{1}/_{32}$in., and the cost was estimated at about one-fifth of that of machine boring.

IT is claimed that a record has been made by the Sankirk Steel Works, of Sweden, in rolling a steel band 360ft. long by 0·0472in. thick and 32in. wide. The previous width of such bands is given by the *Iron Age* as 24in. It is also said that the works are able to roll strip to a thinness of 0·0001182in. It is noteworthy that as long as sixty years ago, as is recorded in our issue of June 23rd, 1871, there was rolled in Wales sheet iron plate so thin that measured by weight it required 4100 thicknesses to make an inch. That means to say that it has required sixty years to reduce the thickness by about one half.

OBTAINING geodetic angular measurements from mountain peaks, particularly rough, needle-shaped, treacherous peaks like those found in British Columbia, towering 6000ft. to 8000ft. above sea level, is more or less difficult and dangerous. Most of this work of the Geodetic Survey of Canada, Department of the Interior, has to be done at night when lights can be seen from distant stations. Electric lights are placed at these stations, and the angles between the lights are measured from the observing station. The lengths of the lines observed vary from 30 to 60 miles. The observer at some of these stations has to exercise great care in moving around his instrument, as a sidestep of only a few inches may mean a drop down the sheer mountain side. The work is usually completed about midnight, when the observer and recorder move down to shelter at the timber-line, their main camp being miles away in the valley.

THE following note from the *Engineering News-Record* is reminiscent of the recent tragedy at Dagenham, but, fortunately, had a more happy finish:—Eleven men trapped in a flooded pipe tunnel at Milwaukee, Wis., on July 19th, were found safe within the air chamber at the headings when the flooded tunnel was pumped out. The tunnel was being built by the Milwaukee Electric Railway and Light Company for steam heating pipes. The shaft was located at the foot of a hill, where water coming down the hill during a downpour of rain backed up on the pavement, rose over the sidewalk, and poured into the shaft of the tunnel, carrying away the small dike built around it to keep out surface water. When the men working in the tunnel discovered the water pouring down the shaft, they took refuge behind the air locks, and remained there until released about six hours later by the firemen, who pumped the water out of the tunnel. A dam of clay and timber has now been built around the shaft head to protect it in case of a similar emergency.

RHENIUM has been isolated as a loose black powder containing more or less hydrogen. This powder, when heated, can be compressed into sticks or bars having considerable strength, much in the same manner as tungsten metal powder is formed into briquettes. When melted in the electric arc the metal is silver-white and exhibits a bright surface resembling platinum and is stable in air. Rhenium is the least fusible of all metals, except, perhaps, tungsten. Some authorities place the melting point at about 3000 deg. Cent., or intermediately between the melting points of tungsten and osmium; but others, including one of the discoverers, believe that it may be higher even than that of tungsten and thus exceeded among known elements only by carbon. There are indications that its boiling point is above that of either tungsten or carbon. The metal is exceptionally hard and is quite strong. The density of the black powder—formed by the reduction of the disulphide with hydrogen—is 10·4, but the fused metal is much heavier, having a density of about 20, exceeding gold and tungsten and approaching platinum in this respect.

Miscellanea.

IT is reported that gold has been discovered in Nowaya Zemlya.

A NEW oilfield is said to have been discovered at Ushuaia, Patagonia.

AN airship hangar is to be built for the United States Navy at Sunnyvale, California.

THE factory of the Bangalore White Lead Syndicate in South India is to be extended.

THE Metropolitan Water Board proposes to spend £2,346,000 on a five-year programme of developments.

THE Model Engineer Exhibition is to be held at the Royal Horticultural Hall, Westminster, from September 3rd to 12th.

THE new lock and inner harbour at Bremerhaven, which can accommodate vessels of 70,000 tons, was opened on August 10th.

DURING June, 23,849 motor vehicles were registered for the first time in Great Britain, as compared with 27,233 in June, 1930.

DURING last year the Tower Bridge was opened 5346 times for the passage of ships, as compared with 5657 times in 1929.

LARGE deposits of coal, said to be similar to the best produced in Wales, have been found in the Xingu River region of Brazil.

IT is reported that the gold reef which has recently been discovered at Ceonwara West, Rhodesia, has panned "as high as 30 oz."

IT is announced that a new port for Rome is to be built at Fiumicino, about 25 miles from the capital, at the mouth of the Tiber.

A SEAM of coal has been discovered near the Aliabad-Teheran railway in Persia. The coal is said to be eminently suitable for locomotives.

THE first report of the Agricultural Machinery Testing Committee has just been published. The Committee was established in 1925.

THERE were 1863 air ports and landing fields of all types in the United States on July 15th, an increase of 206 over the same date in 1930.

THE Lancashire and Cheshire Coal Research Association is about to remove to Park-street, Manchester, where a new laboratory is being organised.

THE new bridge over the river Hull, which replaces the old drawbridge built in 1870, was formally opened on August 10th. It has cost £258,500.

PREPARATIONS for a direct wireless service between Britain and China are being made by the Chinese Government International Wireless Station.

A NEW automatic apparatus for timing the length of trunk telephone calls is being adopted by the Post Office. Its installation will be started towards the end of this year.

A SIDE valve, supercharged Morris Minor car has been officially timed by the Royal Automobile Club, at Brooklands, to have done 100·39 miles per hour over a double course of 1 mile.

A MOTOR cycle of revolutionary design will, says the *Daily Telegraph*, shortly be marketed by one of the oldest Birmingham firms in the industry. Its most striking feature is that skidding is almost entirely eliminated.

IT is said that the deposits of hematite iron ore which have been discovered on the Crocodile River in the Rustenburg district of South Africa contain 68 per cent. of Fe. An adit has pierced 40ft. of this ore without coming to the boundary.

THE Board of the Suez Canal Company has decided that from September 1st next the maximum volume of bunkers allowed to ships in ballast will be increased from 75 per cent.—present rate—to 125 per cent. of the engine-room space shown on the special Suez Canal certificate.

A MESSAGE from Lobito Bay, West Africa, given in the *S.A. Mining and Engineering Journal*, states that the first consignment of copper has arrived there from Katanga. This is the first shipment under the arrangement with the Union Minière, by which 4000 tons of copper and matte will be sent monthly, to begin with, over the Benguela Railway.

IN the Ore Dressing and Metallurgical Laboratories at Ottawa, both large and small-scale work is being carried out on the concentration of copper-nickel, gold, pyrite, lead-silver, and molybdenite ores; the treatment of pitchblende ores; the grinding and treatment of marl, silica sands, and other non-metallics; the beneficiation and treatment of iron ores; and the metallurgy of iron and iron alloys.

A SERVICE is to be inaugurated by the New York Telephone Company by means of which subscribers can obtain the correct time to within one second. Every 15 seconds an announcement will be sent out on the following lines:—"When you hear the next signal the time will be two fifteen and one-quarter." Then will follow the time signal itself. The announcements will be made verbally by girl operators.

A CONGRESS of Electrical Engineers in South America is to be held in Buenos Aires from July 4th to 11th, 1932. It is being sponsored by the Asociación Argentina de Electrotécnicos, and will have the President of the Republic as President of the Committee of Honour. It is hoped that a large number of papers will be submitted for discussion and that local importers of electrical plant will organise an exhibition.

THE Institution of Heating and Ventilating Engineers is appealing for contributions towards the construction of a "controlled weather house." It is estimated that its cost will be from £1800 to £2000, and already the Institution has subscribed £100, while other subscriptions amount to £200. If some further assistance can be obtained, it is proposed to erect a building in which various systems of heating can be investigated in a comparative manner.

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(*For description see page* 165)

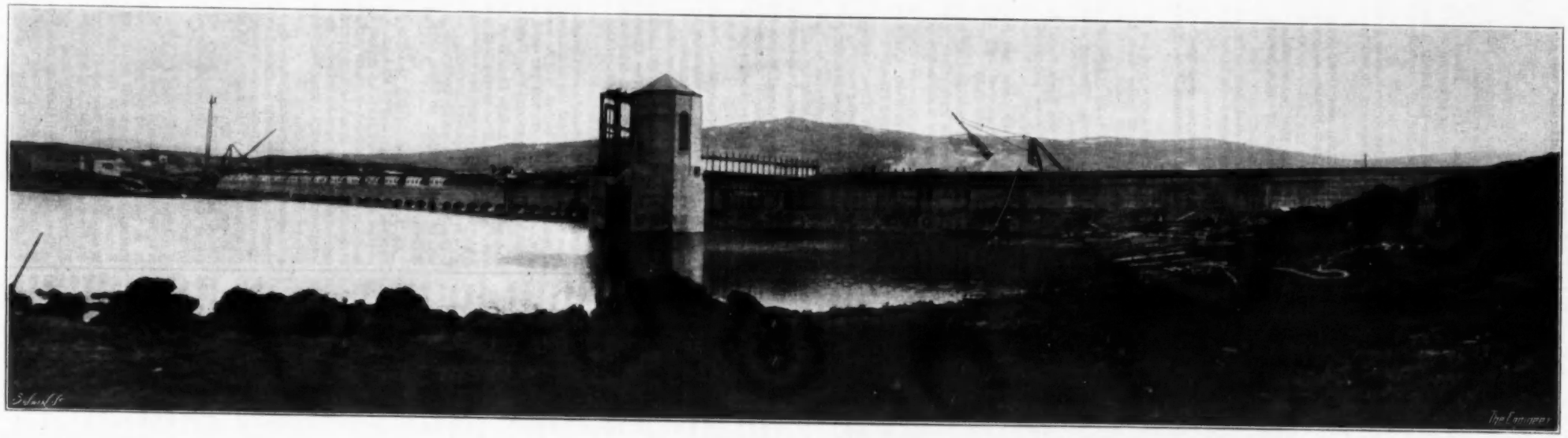

FIG. 13—ERICHT DAM—UPSTREAM FACE

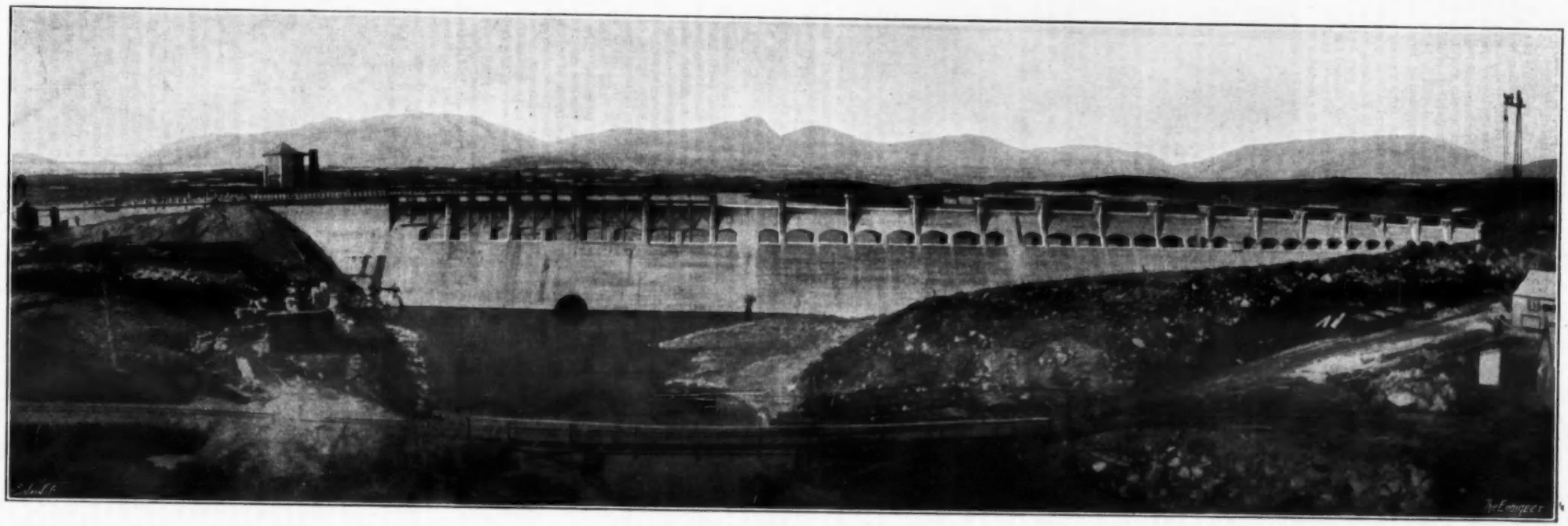

FIG. 14—ERICHT DAM—DOWNSTREAM FACE

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DEATH.

On August 1st, ISAIAH PLATT, M.I. Mech. E., governing director of Isaiah Platt, Ltd., British Empire Works, Wednesbury, in his seventy-first year.

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Industry and the Graduate.

AT the end of the address with which he delighted the Institution of Mechanical Engineers in Cambridge, Professor Inglis touched, with a strain of sadness, upon the subsequent careers of students who had graduated in engineering. "When one inquires," he said, "about the progress of former students, far too frequently it transpires that the more brilliant of them, after two or three years' experience, have left the engineering profession altogether, or at any rate have switched over from the technical side to the administrative side." He indicated as the causes of this lamentable defection, first that the remuneration is "usually so meagre that it is almost an insult," and secondly, that firms who have acquired young men of exceptional ability "have not the foggiest notion how they should be employed." Here we have a double indictment of engineering employers, which, coming from a professor in Dr. Inglis' exalted position, calls for careful examination.

We have no doubt that Dr. Inglis speaks from complete knowledge of the post-graduate careers of his own students, but we do not think it is the general experience of professors that a serious percentage of engineering students leave the engineering profession altogether, though it is quite possible that an ever-increasing number "switch over to the administrative side." Are we to understand that, as Dr. Inglis' words would seem to imply, the defection occurs mainly amongst "the more brilliant men"? Furthermore, are we right in assuming that they leave because the remuneration is so "meagre"? It is rather important that the exact answer to those questions should be known, and we should be very glad if the Cambridge Appointments Board could provide us with an analysis of cases which have occurred during recent years. We seek for this analysis because it is not impossible, nay, it is probable, that Dr. Inglis and employers are taking different views of the value of "the more brilliant men." It may be said, quite frankly, that in ordinary mechanical engineering there are few openings for academically brilliant men. There is, we believe, no evidence that such men show more ability in the solution of ordinary workshop problems than men of a quite different calibre. Indeed, it is not impossible that they leave engineering just because the majority of the problems that have to be solved are not of the kind in which they are interested, or—to put it politely—that they are not retained because, however brilliant they may be as scientists and mathematicians, they lack the power to take responsibility or are deficient in some one or other of the qualities that are useful in industry. It must not be forgotten that the manufacturer does not regard engineering as a scientific pursuit, but as a "business proposition." That does not mean that he takes no interest in science, but it does mean that it is science applicable to his own problems that he cares about. We are confident that any Cambridge graduates who have a real ability for engineering, and have the necessary strength of character and stamina, will not find themselves unwanted, and, moreover, that in due time they will be in a position to take to themselves wives or, as Dr. Inglis had it, "enjoy the luxury of a first-class illness." That brings us to the question of remuneration. There is, we think, a tendency to hold that a young man with a college degree in engineering should be paid a handsome salary just because of his education. Now, no one pays a man for what he knows, but for what he can do with his knowledge. The college education should, as Dr. Inglis himself very rightly insisted, lay the foundation upon which any subsequent edifice may be erected. Until a good deal of experience has been gained nothing useful can be done with that knowledge; it is no more than the "three R's" of engineering, and whilst it is essential as a basis, it is not to be regarded as of exceptional value. It is true that the remuneration offered to experienced men is often deplorably low, but experience is just as subject to the law of supply and demand as any other commodity. The attitude towards the scientifically educated man to which we allude is really a relic of the past, when such men were rare. In these days, when scientific education is open to everybody, it has no particular monetary value, for it is as true in the realm of engineering as in the twin-kingdom of Barataria that "When everybody's somebody, then no one's anybodee." That, we submit, is the light in which the graduate should look upon his education. Without it he would be nobody, but with it he is only the equal of thousands of others. What he can do with that education counts; not the education itself.

Speaking recently in America, Mr. F. W. Willard, of the Western Electric Company, said: "Intellectual accomplishment is at the present time the only objective standard by which the graduate may be measured—and it is not in itself enough. There should be similar standards by which aptitude and personality can be measured." He went on to say that if such standards could be found the technical schools would have fewer men to teach and fewer to graduate, but they would find that all their graduates could be placed in industrial firms simply upon the recommendation of the college authorities. In Mr. Willard's country great efforts are being made to devise psychological tests of the fitness of men for certain occupations; here parents are content to submit their sons and daughters to a gentleman who tells "bumps." There is probably not much to choose between the two methods. It is all too likely that the discovery of genius in the young will never be as easy as ascertaining the fertility of an egg. Hence it is vain to hope that the efficiency of technical colleges—measured by the adequacy of graduates in industrial occupations—will ever be brought to one hundred per cent. by pre-selection; but, working from the opposite direction, something might be achieved. If the colleges—as some of them, we are glad to know, already do—thought less of the scholastic attainment of their students and more of their ultimate usefulness, the proportion of successes would become higher. Dr. Inglis made the interesting suggestion that employers should make places for his more brilliant graduates. That is only possible to a relatively few wealthy firms; too few to absorb the output of all our scientific technical schools. But amongst the smaller firms which form the majority of the engineering industry there are openings for all the graduates that can be produced—if they have the right qualifications—and possibilities for the application of science if it is presented in the right form and in the right way. Every professor knows that it is not the most

brilliant men who succeed most frequently in industrial careers. It is for them to decide whether the failure is due to something lacking in the men themselves or some defect in the method of their education.

The Future of Steam at Sea.

Two records have been established this year by the marine engineers of this country. By attaining an overall fuel consumption of only 0·57 lb. of oil per shaft horse-power, the new Canadian Pacific liner "Empress of Britain" surpassed in economy every steam vessel yet built, while H.M.S. "Acheron," with a corresponding figure of 0·608 lb., has earned the honour of being the most economical steam driven warship afloat. There is nothing to be gained by comparing the two figures, for the machinery of a destroyer has to be designed to meet requirements quite different from those called for in the mercantile service. Both performances will be welcomed, even if only as a portent, by those who believe in the future of steam at sea. The question is not that of coal *versus* oil, for a steam-driven ship has, of course, the choice of either fuel. The real rivalry is between the oil engine and the steam turbine plant. For several years steam has been rapidly losing ground, the oil engine having even established itself in fast passenger liners. Fashion may have counted for something, but steam engineers were almost giving away the battle. Steam plants which savoured of the last century, so far as pressure and temperature were concerned, were pitted against marine oil engines representing the latest achievements of their builders' art. With the highest pressure in the mercantile marine round about 200 lb., and the highest temperature below 500 deg. Fah., steam was not being given a fair chance. Even in naval work conditions were not much further advanced, although water-tube boilers were in general use. Such was the state of affairs at sea only a very few years ago. On land, power station engineers were already awake to the greater possibilities of steam, and had begun to realise them. Marine engineers, in general, hung back, finding their excuse in the admitted differences between power stations and ships, rather than deriving encouragement from the many points of similarity.

It was fitting that the impetus to adopt higher steam pressures and temperatures should have come from the late Sir Charles Parsons, who had already effected revolutionary changes in marine engineering by providing first the turbine and later the reduction gear for steam-driven vessels. The "King George V.," which went into service in 1926, will rank, after the "Turbinia" and the "Vespasian," as embodying the third great advance in the use of steam at sea. With a pressure of 550 lb. and a temperature of 750 deg. Fah., the steam conditions were more severe than in any British power station at the time, yet the results were so satisfactory that Sir Charles Parsons stated that his company was quite prepared to construct turbine machinery for pressures up to 1000 lb., and saw no difficulty in the application of such pressures. The "King George V." ran with a coal consumption of 1·085 lb. per shaft horse-power, or 30 per cent. better than similar vessels on the same service. The experiment proved that high pressures and temperatures were as safe and practicable at sea as on land, provided that equal care was taken to ensure pure feed water. It also demonstrated the economy of the system convincingly enough to bring about a complete change of attitude on the part of marine engineers towards higher pressures. In the five years that have elapsed since the "King George V." led the way, the progress towards better steam conditions has been very striking. The Canadian Pacific Company, with characteristic enterprise, ordered almost immediately four liners of 16,000 shaft horse-power each, to work with steam at 350 lb. pressure and 680 deg. Fah. temperature. The first of these ships, the "Duchess of Bedford," went into commission in 1928, and justified her designers by making a striking economy record, her fuel consumption being only 0·625 lb. of oil per S.H.P for all purposes. The next year produced the Holland-Amerika liner "Statendam," of 20,000 S.H.P., with steam at 400 lb. and 625 deg. Fah., although the designers of the German liner "Bremen," also of 1929, did not go beyond 330 lb. In 1930 the Canadian Pacific Company beat its own record by building the "Empress of Japan," of 30,000 shaft horse-power. This vessel, with steam at 425 lb. and 725 deg. Fah., had an overall consumption of only 0·603 lb. per shaft horse-power, and now the "Empress of Britain," with the same steam conditions, has beaten every steamship afloat, with an overall consumption of only 0·57 lb. per shaft horse-power. This figure was obtained on a twelve-hour trial at mean ocean displacement, with all hotel services in operation, so that it may fairly be taken as representing the efficiency that will be obtained under ordinary working conditions.

It is inevitable that the figures given above should be brought into comparison with the performances of motor-driven ships. Mr. J. Johnson, the superintending engineer of the Canadian Pacific Line, indeed challenged a comparison in his paper before the Institution of Naval Architects in 1929, although at that time the best that steam could show was represented by the performances of the "Duchess" class. Before the "Duchess of Bedford" was ordered, Mr. Johnson obtained prices for the construction of a similar vessel with oil engine machinery, and found the cost would have been £100,000 more. Taking the consumption of the latter vessel as 0·48 lb. against 0·63 lb. for the steamer, and allowing for the higher price of Diesel oil as compared with fuel oil, he made out an overwhelming case in favour of steam. Even if boiler oil and Diesel oil were obtainable at the same price, and the oil engine installation could be operated with no charges at all for repairs, steam still was the more profitable proposition, besides involving less weight of machinery, including boilers, fuel, and feed water. Coming from an engineer of Mr. Johnson's standing and experience, these conclusions have to be accepted, though obviously they must not be stretched to cover all kinds of ships on all routes and in all trades. The widespread adoption of the internal combustion engine at sea is sufficient proof that many owners are satisfied that it gives the cheapest service for their particular requirements. There is no real ground for deprecating it, because it involves reciprocating instead of rotating machinery, for both motor cars and aeroplanes are exclusively driven by reciprocating engines, with an equal multiplicity of cylinders and moving parts. Mechanically, the heavy oil engine has proved its complete suitability for marine work. If it is to lose the field it has won from steam, the reason will probably be found in the fact that its present margin of thermal superiority will become too narrow to enable it to retain its position. The thermal efficiency of an internal combustion engine has already reached 37 per cent. or so, and there seems no reason to believe that this will ever be materially exceeded. The only paths open for designers are to reduce cost and weight for a given power. The designer of steam machinery may have somewhat less scope in these directions, though no doubt he can do something too. He has, on the other hand, relatively vast possibilities of securing greater efficiency. With large turbines running under constant full load, and with the whole ocean to draw on for circulating water, the conditions are admirable for economical operation. There are already signs that advantage is being taken of them to give steam a real chance. Efficiencies have increased by leaps and bounds, since higher steam pressures and many of the heat-saving devices of land practice were introduced on ships. Now that a start has at last been made and engineers of the mercantile marine have got over their distrust of the water-tube boiler, there seems no reason at all why steam pressures at sea should not be as high as in any of the large power stations on land. The central station engineer, faced with the violent daily and yearly irregularities of the demand on his plant, might well envy the steady load of a steam ship. Such a load would seem to justify an expenditure on equipment which might not be warranted in a power station, and thereby provide a possibility of still greater economy. Even more important, however, for the future of steam at sea may be the attempts which are being made to burn coal in pulverised form or on mechanical stokers. With coal used to the best advantage in the stokehold, and steam giving the best that is in it, the motor ship would know what competition really was.

Literature.

Elementary Hyperbolics. By M. E. J. Gheury de Bray. London: Crosby Lockwood and Son. Two volumes. Price 7s. 6d. each.

In 1921 there was published a little book written by Mr. Gheury de Bray, and entitled "Exponentials made Easy." It was a modest work and at the outset its reception was disappointing. Its style throughout was unorthodox, and at times it became positively unacademic. The thoroughbred mathematician doubtlessly sniffed at it, but it was a serious contribution to mathematical literature, and in due course the book became widely known and highly valued among a large circle of struggling students. It marked a welcome departure in mathematical exposition, and to many readers in different lands it proved helpful, stimulating, and attractive.

It was not intended that the book should stand by itself. From the outset it was meant to be only a preliminary to a treatment of imaginary quantities and hyperbolic functions. Ten years after its appearance, and in response to a large number of requests, Mr. de Bray has now given us its sequel in two volumes. In the earlier volume he recounted the story of "epsilon," the number otherwise known as the base of the Naperian logarithms. In the first of his new volumes he starts by discussing the meaning of $\sqrt{-1}$, and then passes in an easy and natural manner to complex quantities and the various ways in which they can be expressed, ending with the exponential form. Then follows a lengthy section in which the reader is introduced to sinh and cosh, and tanh and their relationship to the rectangular hyperbola. Before he is finished with this section the student will find himself on familiar terms with the catenary, with the function known as the Gudermannian, and with the expression of continued fractions in terms of hyperbolic functions, and will at least have made a bowing acquaintance with elliptic integrals. The first volume concludes with a section on the hyperbolic functions of complex angles, followed by some notes on the tabulation of hyperbolic functions in general.

The second volume is devoted to a discussion of the applications of hyperbolic functions. The principal application with which Mr. de Bray deals is their use in the theory of the propagation of electric currents in long conductors, but we are also told something concerning their employment in geography and navigation, in the solution of cubic equations and certain differential equations, in the theory of catenary suspensions, and in connection with some problems in elasticity.

From this summary of the contents of the two volumes it might appear that on the whole the work follows familiar lines. It is not, however, so much in the ground covered as the manner in which it is covered that the value and attractiveness of the volumes reside. They are written in a spirit displaying sympathy with and a very full understanding of the ordinary student's difficulties. Occasionally, in unexpected places, the reader encounters refreshing touches of humour—mathematical jokes, in fact—but it would be wrong to convey the impression that Mr. de Bray has treated his subject in any spirit of levity. He is a road-mender. He has smoothed out the hills and bridged the pitfalls which abound in the orthodox text-books, and makes our journey a joyous progress instead of a toilsome tramp. But he is also something more than a road-mender. In the act of removing our difficulties he does not, as he might easily have been led into doing, restrict his survey of the fields through which he leads us to a cursory incomplete examination. Thoroughness is his watchword, and so thorough is he that in at least one instance, the expression of continued fractions in terms of hyperbolic functions, he lays before us for our comprehension a subject which has hitherto never found its way into a mathematical text-book.

The volumes are described as being intended for technical and other students, and as being specially adapted to the requirements of beginners. Junior students will assuredly find them useful. With equal assurance it can be said that many readers who are not juniors and who have long since passed their days of nominal studentship will derive pleasure and advantage from them.

We are glad to observe that Mr. de Bray's labours are not yet complete, and that he has now in preparation a book to be entitled "Determinants and other Calculating Dodges." It is in harmony with his manner to fling a stone at mathematical dignity by calling a determinant a dodge. He has already flung numerous stones at the same target and has succeeded in letting a welcome blast of fresh air into the dusty regions of mathematical exposition. In his present venture and that which is to come we wish him continued success.

BOOKS RECEIVED.

Experimental Radio Engineering. By J. H. Morecroft, D.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

Vergleichende Untersuchung von Trockenstoffen. By H. Wolff. Berlin: V.D.I. Verlag G.m.b.H., Dorotheen-strasse 40, N.W. 7. Price 4·50 marks.

Possible Cause of Aircraft Fires on Crash. By W. G. Glendinning, B.A. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

The Flutter of Monoplanes, Biplanes, and Tail Units. By R. A. Frazer, B.A., and W. J. Ducan, D.Sc. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 7s. 6d. net.

Kingston's Price Equivalent Tables: "Per Yard and Metre" and "Per Pound and Kilogram." London: Kingston's Translation Institute, 96–98, Leadenhall-street, E.C. 3. Price 2s. net per copy.

Report on Conferences between Employers and Inspectors concerning Methods of Suppressing Dust in Asbestos Textile Factories. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Obituary.

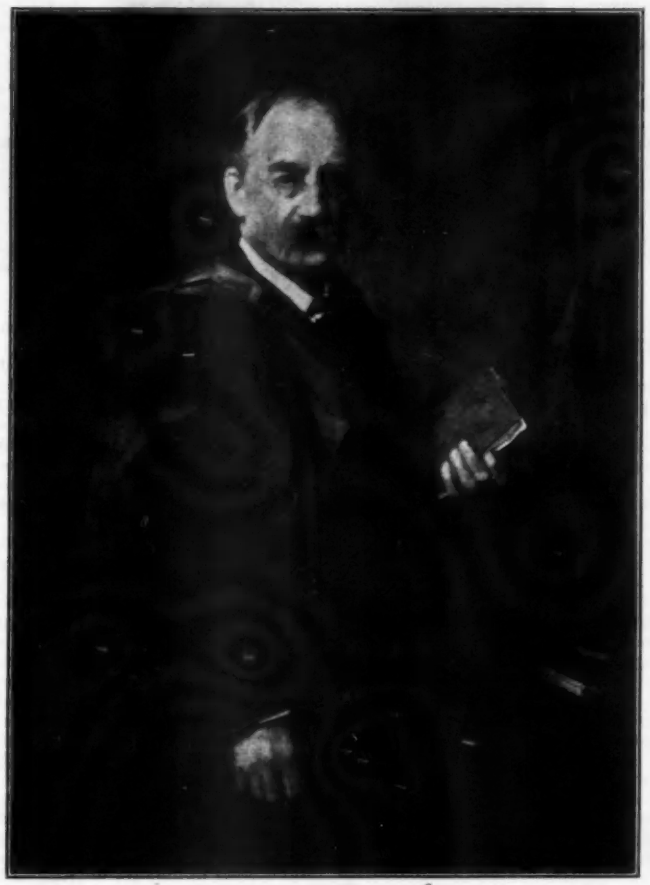
ARCHIBALD BARR.

By many engineers up and down the world, in high quarters and in low, news of the death of Dr. Archibald Barr will have been received with a feeling of direct personal loss. It has robbed them of an old friend, who was not only the able instructor of their youth, but an example in all things and to everyone of what a mechanical engineer should be.

From 1889 to 1913 Dr. Barr was Regius Professor of Civil Engineering and Mechanics at Glasgow University. It was no light duty to assume a chair that had just been vacated by James Thomson, and that previously had been occupied by Macquorn Rankine and Lewis Gordon. The Chair of Engineering was founded at Glasgow University by Queen Victoria in 1840. It was the first of its kind in this country, probably in the world. Of Gordon, its earliest occupant, we, to-day, perhaps, remember little, except that he gave us a formula for the strength of columns. Of Rankine, poet, engineer and mathematician, founder of the modern theory of ship propulsion, and part founder of the science of thermodynamics, there is no need to write; his influence will remain as long as the world requires engineers. Of his successor, the delicate, retiring James Thomson, the worldly fame would have been greater than it was had it not been overshadowed by that of his younger brother, Lord Kelvin, the occupant of the Chair of Natural Philosophy in the same university. Yet Thomson's name will also survive in the history of engineering, particularly in its hydraulic branches, and in general as that of one who, in a very remarkable degree, combined scholarship with practical intuition. It was to these men that Archibald Barr was called upon to succeed. The task involved in maintaining the high standard which they had set was a difficult one. As a former pupil of, and subsequently assistant to, James Thomson, he was, however, in a position to carry on the traditions of the Chair of Engineering. For the next twenty-four years, he continued to occupy the Chair with distinction to the University, and with profit of mind and character to all who came under his influence.

His tenure of the position surpassed in duration that of any of his forerunners. In its own way it equalled, if it did not surpass, them in its effect on the rising generations of engineers. It was not distinguished, as Thomson's and Rankine's had been, by the development and promulgation of new doctrines and theories. Indeed, except for a study of the comparison of similar structures, in which he continued a theme begun by James Thomson, Dr. Barr's professorate cannot be said to have been marked by any outstanding new contribution to engineering knowledge. His genius took another form. He was a highly gifted practical engineer, and in the lecture room he exhibited in a remarkable degree the power of imparting his knowledge to others. He possessed a rare capacity for stimulating in his students the ability to think for themselves, and it was his constant care to see that they should think along practical lines and never become worshippers of theory for theory's sake. As a teacher his success may be judged from the fact that when he took office in 1889, there were only thirty-six engineering students at Glasgow University. When he resigned in 1913, the number had increased to over two hundred, and included many students from England, the United States, China, Japan, and other countries. His abilities as an expositor have been passed on and several of his old pupils to-day hold high professorial rank. One of them has succeeded him. Just as James Thomson was a student under Lewis Gordon, and as Dr. Barr was a student under Thomson, so, too, Dr. Cormack, his successor, and the present occupant of the Chair, studied under Dr. Barr. Thus has tradition in the teaching of engineering science been preserved and its value recognised.

Dr. Barr was no pedant. In the drawing office one day he criticised a student's work. The student defended his design and stated that it was in accordance with the formula which he had given in his lecture that morning. "May be it is," said the Professor, "but it looks a wee bit nippit to me. Give it another quarter of an inch." To parody Cromwell's advice to his soldiers, his students were taught to put their faith in formulas, but to keep their judgment handy. The strong practical trend of his instruction was reflected throughout the whole curriculum of the engineering classes. The University, he maintained, was no place in which to teach manual dexterity. Of workshops there were none attached to the engineering laboratories. If Dr. Barr did not invent the "Sandwich" system, he did everything in his power to develop it. In the five or six summer months, the lecture rooms were silent and the laboratories deserted. The students had departed for the time being to the shops of the neighbouring engineering establishments to continue their apprenticeships. In that way practical experience was gained side by side with scientific knowledge to the undoubted benefit of both. The idea that anyone simply by attending the University could become an engineer was severely discouraged, although the system did not go so far as to make practical workshop experience compulsory in a candidate for the engineering degree.



Yours faithfully
Archibald Barr.

Archibald Barr was born at Glenfield, near Paisley, in 1855. He died at his home, Westerton of Mugdock, Milngavie, near Glasgow, on Wednesday of last week, August 5th. With the exception of a short period of residence in England, the seventy-six years of his life were spent in Glasgow and its neighbourhood. He was educated at Paisley Grammar School and served his apprenticeship with A. F. Craig and Co., a firm, the founder of which, Mr. Archibald Craig, died only a month ago in his ninetieth year. In 1876 he graduated in engineering science at Glasgow University, and for eight years afterwards he served as assistant to Professor James Thomson. In 1884 he was appointed to the Chair of Civil and Mechanical Engineering in the Yorkshire College, Victoria University, now the University of Leeds. During the five years of his office at that College, he equipped and organised the engineering laboratory and made it one of the most complete departments of its kind existing at that time. In 1889, he was recalled to Glasgow to succeed Thomson, who had been forced to resign on the score of ill-health. He found the lecture room accommodation inadequate and the laboratory poorly equipped and housed in a basement. With characteristic energy and determination he set about arousing interest in and collecting funds for the establishment of an engineering department worthy of the University and of Glasgow. His labours came to fruition in 1900, in which year the James Watt Engineering Laboratories were completed and opened. It was a self-contained department, with lecture rooms, drawing office and laboratories generously equipped with experimental apparatus, including, as was only natural, a very fine hydraulic laboratory. The department has since served as a model for many others elsewhere.

In addition to his professorial duties, Dr. Barr engaged in external consulting work, chiefly in connection with engine and boiler installations, and took an active interest in the leading engineering and scientific societies in Glasgow and London. At different times he was President of the Institution of Engineers and Shipbuilders in Scotland, of the Royal Philosophical Society, of the Scottish Aeronautical Society, and of the Mechanical Science Section of the British Association. In 1901 he supervised the first motor car reliability trials held in Scotland, and in the same year he acted as convener of the Engineering Section of the Glasgow International Exhibition. In 1910 he was chairman of the committee which organised the first aviation meeting held in Scotland at Lanark.

Of all his interests outside the University, by far the chief was one which had its origin while he was still at the Yorkshire College. A year after his appointment, Dr. William Stroud came to the College as Professor of Physics. The two young scientists became close friends, Dr. Barr bringing to the partnership gifts of mechanical invention and organising ability and Dr. Stroud a penetrating insight into the scientific core of a problem. In 1888, they were on the point of starting a research on the mechanical equivalent of heat when they chanced to notice an advertisement by the British War Office calling for an instrument to measure ranges for gun fire. Within three weeks' time they had evolved between them the essential features of the modern range finder. The first instrument was tested at Aldershot in the following year in competition with others of various types. The results obtained were sufficient to promise the possibility of effecting improvement with experience. On removing to Glasgow, Dr. Barr remained in touch with his former colleague and between them they continued the development of their range finder. Dr. Barr, at this period, made many of the parts required with his own hands and adjusted them from a platform on the roof of his house in Glasgow.

In 1891 the Admiralty advertised a public competition for naval range finders and specifically asked Dr. Barr and Dr. Stroud to submit an example. The Barr and Stroud instrument tested in 1892 on H.M.S. "Arethusa" more than satisfied the requirements as to accuracy and demonstrated its value to the service. A demand for the instrument at once arose. In 1895 a workshop for the assembly of the range finder was opened in an old stable and later another old building in the neighbourhood was occupied for the same purpose. At that time the parts of the instrument were made by a firm of scientific instrument makers. The demand continued to grow and in 1904 the first portion of the existing factory at Anniesland on the western outskirts of Glasgow was opened with a staff of about a hundred men. By 1914 the establishment had grown to a factory employing 900 men and was supplying naval and military range finders to the British Government and nearly every other important foreign power. During the war the main building was extended, and two new buildings were added to provide accommodation for a total of over 2000 workers.

The Anniesland factory was from the outset an exceptional example of a modern manufacturing establishment. The work being largely optical and calling for a quite exceptional degree of accuracy, demanded organisation on novel lines. It was a task after Dr. Barr's heart and he showed in its fulfilment that he was as much at home in the workshop and the office as he was in the lecture room. His well-balanced mind enabled him to reach a sound conclusion quickly and to distinguish the commercial and financial aspects of a problem from the practical and scientific. He was an early advocate of welfare work and of the premium system and took a keen interest in all problems of manufacture and factory development. In 1896 he visited the United States to study American machining methods, and

two years later installed in his works the first American milling machine to come to Scotland.

While the names of Barr and Stroud are widely associated with range finders, instruments of this class were by no means the only devices to which Dr. Barr devoted his attention. In 1905 he invented a step-by-step motor for signalling electrically from the range finder station to the guns and thereafter he designed and patented many other instruments connected with the fire-control system of a modern warship. In 1912, or earlier, he developed an electrically operated torsion meter for measuring the power of large prime movers.

During the war the firm was naturally faced with the problem of greatly increasing its output of range finders. In spite of this additional activity, however, Dr. Barr found time to devise a number of new instruments for naval and military use, including a torpedo depth recorder, a bomb-dropping sight for aircraft, a height finder for anti-aircraft services, and a submarine periscope. Incidentally, he took a prominent part in establishing the manufacture of optical glass in this country on an improved basis.

After the war his attention was turned towards civilian work. He became interested in the "Optophone," an instrument embodying a photo-electric cell, whereby the blind were enabled to read ordinary type. Among the other directions in which he applied his great abilities, mention may be made of the invention of a pump for the production of very high vacua, and of a series of instruments for the production of contour maps from air survey photographs.

Dr. Barr was a member of the Institutions of Civil and Mechanical Engineers and of the Institute of Metals. In 1923 he was elected a Fellow of the Royal Society. In 1914 he was made a Doctor of Laws of Glasgow University. The accompanying engraving is reproduced from a presentation portrait painted in 1914 by Mr. Fiddes Watt, which was executed at the request and expense of his students and former students and which now hangs in the University.

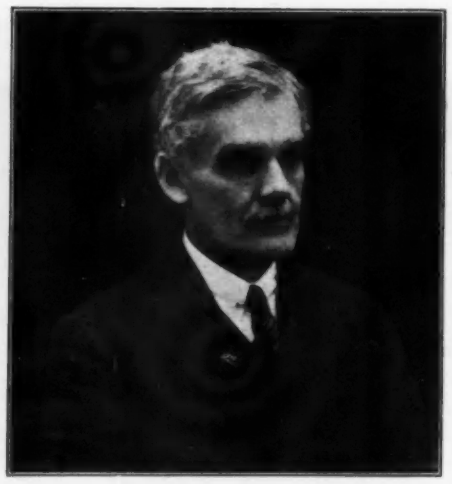
REGINALD CHARLES CLINKER.

By the death of Mr. Reginald Charles Clinker, who, as we announced in our last issue, lost his life as the result of an accident on Monday, August 3rd, an exceptionally able and well-known engineer has been removed from the manufacturing side of the electrical industry. While mountain climbing in North Wales, with a small party of friends, Mr. Clinker slipped and fell 200ft. into a rocky gully, thereby bringing his distinguished career to a tragic end. He was born at Yeovil, Somerset, in 1874, and was the third son of Charles Clinker, proprietor and editor of *The Western Gazette*. His early education was received at Sidcot School, Somerset. Subsequently he attended the Craigmore College, Clifton, the Bristol University, and the London University, and during his university training he gained an exhibition scholarship for two years. He began his career as a research worker under Professor J. A. Fleming.

When the B.T.H. Company was formed in 1896, he became one of the first members of the technical staff. Together with Dr. Parshall and Mr. H. M. Hobart, the chief of the B.T.H. technical department, he was engaged for some time in a research on the magnetic ageing of iron, a matter which, in those days, attracted considerable attention. When Mr. Hobart resigned his position with the B.T.H. Company, the technical department, which he had organised, was left in charge of Mr. Clinker, who, although then quite a young man, successfully grappled with many difficult problems. About that time the company was busily engaged on the electrical work of the Central London Railway, and it was whilst the sub-station plant was being put into service that Mr. Clinker first became known to us. Later, he specialised more or less on transformers, but experimental work always strongly appealed to him. In 1913, he became interested in wireless work, and in this connection he also displayed marked ability. During the war he played an active part in the production of valves for the Forces. At a very early stage in wireless development he invented a portable receiver with a self-contained aerial, a form of apparatus which has since acquired considerable popularity. For much of the experimental work involved in the development of the B.T.H. magneto, Mr. Clinker was responsible.

In 1920 he joined the staff of the company's consulting engineers, and when the engineering laboratory was established in 1924 he was appointed chief of that laboratory. Under his direction the work of the department rapidly developed. Owing to indifferent health, however, he ultimately found the duties and responsibilities too heavy for him, and in 1929 he resigned the position, although he continued to act as a research engineer for the company. In this capacity he devoted his attention to a wide range of subjects, including the talking film. He was a practised and gifted lecturer with unrivalled clarity of expression, and was skilled in the art of devising and performing instructive experiments. The experimental lecture he delivered at the B.T.H. works on "The Growth and Development of Talking Pictures," on the occasion of the visit of the South Midland Centre of the Institution of Electrical Engineers to those works last month, and referred to in our issue of July 10th, was a remarkable performance which few who were present will readily forget. He was never too busy to deliver a lecture if his services were required, or to explain the objects and principles of his experimental apparatus to individuals who appealed to him. At the Physical and Optical Societies' exhibitions, he invariably proved an ideal demonstrator of the apparatus under his care, and he spared no pains to enlighten visitors who sought information.

In models for demonstrating electrical principles he took a keen interest, and when some years ago we were preparing a series of articles on these models he readily came to our assistance. His oscillating valve model he described in a paper read in 1923 before the Wireless Section of the Institution of Electrical Engineers, of which he was a member. During the year 1929–30, he was President of the Rugby Engineering Society. He made several trips to America, where he was also well known in electrical circles. In addition to his professional work, he had many interests, and astronomy and music were among his



R. C. Clinker

recreations. All who knew him will deeply regret his death, for, apart from the services he rendered to the electrical industry, he was a charming man who never seemed to attach importance to his own achievements.

WALTER ARTHUR EDGAR WOODMAN.

It is with regret that we have to record the death on August 7th, following an operation, of Mr. W. A. E. Woodman, the research engineer of the Vacuum Oil Company, Ltd., of Caxton House, Westminster. Mr. Woodman, who was in his sixtieth year at the time of his death, was born at Tring, and received his early education at the Tring Grammar School. He served his apprenticeship with the Derby firm of George Fletcher and Son, Ltd., and afterwards joined the firm of Simpson, Strickland, the shipbuilders and marine engineers of Dartmouth. At a later date Mr. Woodman joined the Liquid Fuel Company, of Cowes, Isle of Wight. For some years after leaving Cowes he worked with the late Dr. Ferranti on steam turbine research experiments, which eventually were continued at Barrow, when this work was taken over by Vickers, Ltd. In 1912 Mr. Woodman joined the technical department of the Vacuum Oil Company, Ltd., and he had charge of the firm's research work. He was the designer of the "Delvac" mechanical lubricator. Mr. Woodman was retiring in character, but his genial personality endeared him to all with whom he came in contact. He ungrudgingly shared his wide knowledge of engineering work and his broad experience with all who sought his help, and, in particular, many of the younger members of the firm's engineering staff owe much to his kindly help and guidance. His loss is keenly felt, both by his company and all those who were called upon to work with him at Caxton House.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SHEAR STRESS IN HELICAL SPRINGS.

Sir,—I have read with interest the article by L. E. Adams on the "Shear Stress in Helical Springs," which appeared in The Engineer of June 26th.

It has long been customary to use the shear stress derived from the simple equation for torsion as the criterion of the strength of the spring, although possibly it has also been known that other stresses may have an appreciable effect in certain designs. Reasons for this approximation are that as a rule the angularity of the coils in springs is such that the bending stress alone can only be small, so that the percentage error involved is not important, and, further, in view of the irregularities in dimensions of actual springs, it has been considered with some justification that refinement in determining the stresses is unnecessary.

The Röver effect discussed by Mr. Adams has not received the same attention as the other sources of strain, but when the stress resulting from it is added to those due to the subsidiary and previously neglected effects, the total addition of stress is important, particularly in springs having a high ratio of coil to wire diameter. The simple stress alone is then inadequate as a criterion of the strength of the spring. Particularly is an accurate determination of the strength in springs required, as for some unexplained reason springs are expected to work with a much smaller margin of safety than other pieces of a mechanism.

Mr. Adams has chosen an example of a spring in which the stress due to the Röver effect is large, but in aircraft springs, which have neither a low ratio of coil to wire diameter nor excessive angularity of coil, the increment of stress due to Röver and other subsidiary effects can hardly be neglected. I am indebted to Mr. Evans, of the Royal Aircraft Establishment, for obtaining a comparison of the simple torsional stress with the total stress in some aircraft springs, and he finds that in the examples tried the average increment of stress is of the order of 15 per cent.

Incidentally, it may be mentioned that Timoshenko, in his "Strength of Materials," Part I., page 83, refers to the same effect, and quotes a very simple formula* to give the total stress in a close-coiled spring. Stresses obtained from this formula agree with reasonable accuracy with those obtained from the graphs provided by Mr. Adams.

* Max. shear stress $= \frac{16\,P\,R}{\pi d^3}\left(\frac{4m-1}{4m-4}+\frac{0{\cdot}615}{m}\right)$

where $m = \frac{2\,R}{d}$

Andrew Swan.

Royal Aircraft Establishment,
South Farnborough, Hants, August 7th.

"IN THE HANDS OF THE BANK."

Sir,—I have hesitated to reply to your correspondent of April 24th on the above subject, owing to the great distance I am away from home, but as none of your readers have replied so far, I feel that the statements contained therein should not be allowed to go unchallenged.

I agree with your correspondent that the subject is of the utmost importance, and especially so to engineers at the present time. Further, I would counsel every young engineer who hopes to succeed in his profession to obtain a sound knowledge of both sides of a balance sheet, some knowledge of buying and selling, and ever to keep before him the word "money." The mishandling of money has wrecked many brilliant careers and brought many great firms to the dust.

Your correspondent desires a clear understanding as to exactly what it is which banks lend to industry. The answer is "money," and only money. Mr. McKenna was quite right: "Every loan creates a deposit and the repayment of every loan destroys a deposit." Before we reach this stage, however, the loan—*i.e.*, money—has to be bought and paid for. This is the cause of the whole trouble. Money, like all other commodities, has to be bought and sold. Its value fluctuates like that of all other commodities, and it is frequently bought by those who cannot afford it.

It is useless to blame the banker when things go wrong, because his job is to buy and sell money to the best advantage.

Turning now to your correspondent's example:—"No. 10 receives a large order; he needs ready money, and the banker agrees to an overdraft of £100." Surely your correspondent is not so simple as to imagine that the banker advances this overdraft without any security. What happens is that a lien is placed over about £300 worth of our manufacturer's assets, and it is against this added asset of the banker's that the overdraft is advanced, so that whilst the banker's liability has increased to £1100, his assets have increased to £1300.

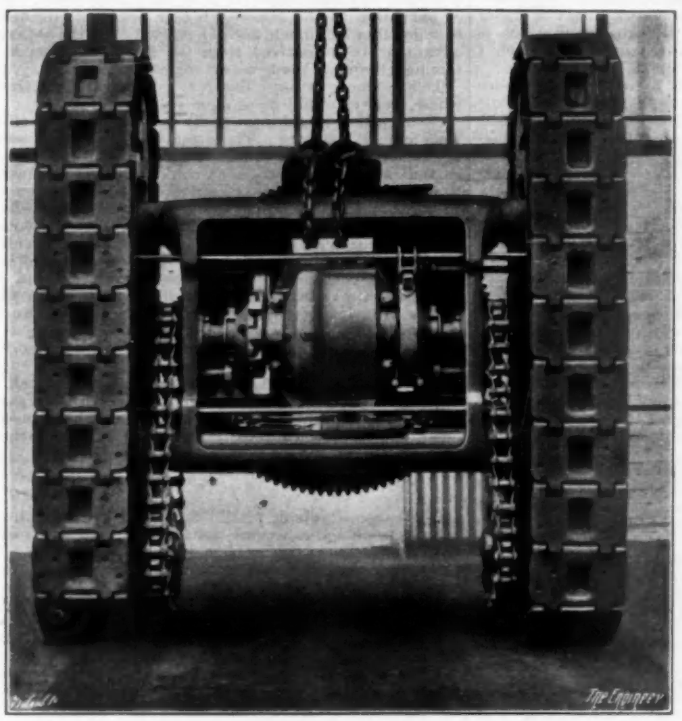
It is this point which is so important in company finance, because unless our manufacturer is assured of enough return on his order to repay the overdraft plus interest thereon plus working expenses plus overhead expenses plus some profit, then the shareholders' assets are irretrievably lost, and the concern must get more and more into the hands of the bank. As time goes on, the shareholders part with more and more of their assets in order to buy more money from the bank, until a stage is reached at which the bank calls a halt. It is then discovered that as a preferential creditor the bank owns the firm and has literally bought it for about one-third of its value. If in the meantime, as usually happens, values have fallen, the bank will probably be lucky to realise the value of the money lent—*i.e.*, one-third of the original value of the assets—the shareholders and unprotected creditors getting little or nothing at all.

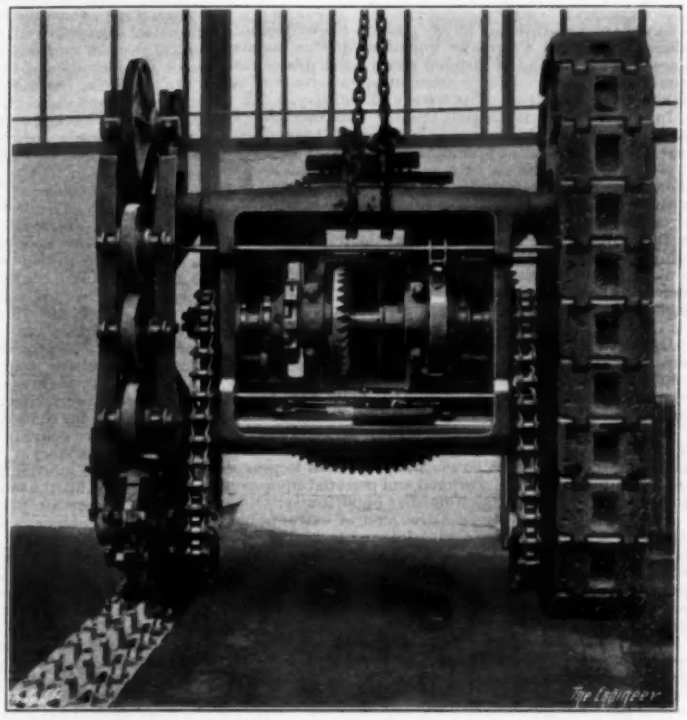
Your correspondent's mathematics remind me of those delightful problems Professor Perry used to set us about a man selling a few green peas at an enormous profit at the beginning of a season and selling a whole lot at a small loss towards the end, and we had to discover a law for selling green peas. Delightful as mathematics, but having no connection whatever with the business of selling green peas or money.

A mathematical, or in fact any, expression, to be of

A NEW CATERPILLAR MOUNTING FOR EXCAVATORS

RUSTON-BUCYRUS, LTD., LINCOLN, ENGINEERS





value, must stand testing, and I ask your correspondent to test his reasoning when nine of the ten depositors require overdrafts instead of one. This is invariably what happens in boom times. Everybody requires money at the same time, with the inevitable result that it becomes dearer and dearer. It seems very late in the day to me to have to remind your correspondent that one cannot get something for nothing, and that is what he is trying to make us believe.

There is no doubt that the engineer must control the engineering industry, but if a banker is the owner or part owner of the business, he would be a very useful member of the board and should be welcomed. The trouble at present is that most engineers cannot meet the banker or financier on a common level, and most of the trouble would disappear if every engineer realised that every pound expended by him, whether productively or not, has its inevitable effect on the profit and loss account.

T. H. SILK, M. Inst. C.E.

Balmain, Sydney, N.S.W., July 3rd.

PROFIT-SHARING IN 1930.

SIR,—In your comment on the annual return of the Ministry of Labour about profit-sharing you observe that in the engineering group of forty-four firms only 21,100 workpeople were participators out of 79,000 employees.

This percentage is very low, and is due to the fact that several of the forty-four schemes are of a type, sometimes called "voluntary," in which the profit-sharing consists in the payment of high rates of dividend upon capital purchased by the employees or deposits made by them. There are 100 such schemes altogether, and of their 284,200 employees, only 50,400 are actually participating.

In the 229 schemes in which the first step is the sharing of profits with the employees, of 183,000 workers 154,800 participate—*i.e.*, all after a period of qualification. This is a very important point because the spirit of co-operation and co-partnership can hardly be generated unless all the workers are brought into this new relation of partners.

In many of these 229 schemes the employees are given opportunity to use the money provided by profit-sharing for the purchase of capital. In the fifty-nine gas companies the 44,245 employees own capital with a present-day value of £3,148,000.

Undoubtedly, an increasing number of businesses, including many smaller ones, are practising co-partnership or methods approximating to profit-sharing, though not conforming to rigid definition. As soon as trade revives there will be another move forward.

Meanwhile, the Industrial Co-partnership Association, 1, Gordon-square, W.C. 1, is ready to give information to all inquirers, and especially to those who are thinking of introducing the principle into their own businesses. The literature of the Association shows that schemes are working successfully in a wide variety of trades and businesses.

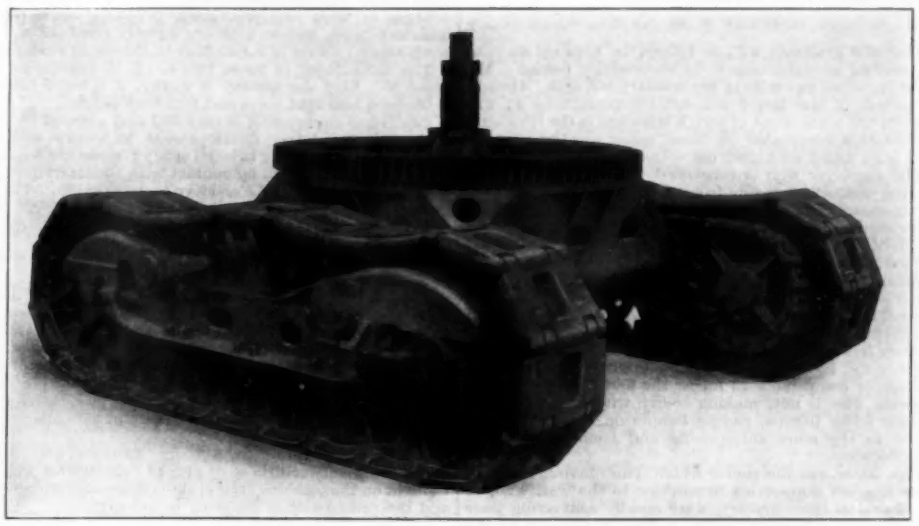
E. W. MUNDY,
Secretary.

Industrial Co-partnership Association,
1, Gordon-square, London, W.C. 1,
August 10th.

A New Caterpillar Mounting for Excavators.

A NEW form of caterpillar mounting, which has recently been embodied in the construction of the excavators manufactured by Ruston-Bucyrus, Ltd., of Lincoln, is illustrated by the accompanying engravings. It is intended for machines of up to about 50 tons in weight, and, as will be seen, it embodies chain drives.

In the matter of having chain drives the mounting is not altogether novel, as some of the earlier excavators had chains, but it was found that the chains then available were not capable of standing the heavy stresses and shocks of the service. So, toothed gearing was generally adopted, which meant added complication. The chain makers have, however, now succeeded in producing chains capable of standing up to the work, and their chains have been subjected to field tests for some time past with complete satisfaction.



COMPLETE CATERPILLAR UNIT

The chain naturally reduces the number of moving parts—that is to say, of course, if the chain is considered as one part—and makes a more accessible drive, while it will accommodate itself to straining of the frame. The framing of this mounting is, however, sufficiently rigid to reduce that contingency to a minimum.

The main driving shaft from the engine reaches down through the centre post of the crane, and carries a bevel wheel at the bottom. This wheel drives a short transverse shaft, on either end of which there is a dog clutch. In line with this shaft there are two other short outside shafts, each of which is fitted with the counterpart of the clutch, and with a sprocket for the driving chain. By manipulating the clutches, through passing down the centre post, either or both of the caterpillar tracks can be driven, and the machine driven forward or steered round corners. A two-way brake is fitted round the circumference of one of the clutches and prevents the machine travelling in one direction, while it is free in the other. The brake is also useful in holding the machine up to its work in digging and in going up steep slopes. The bevel gearing is totally enclosed and runs in an oil bath.

Another improvement in the new mounting is the addition of another roller for transmitting the weight from the frame to the track. There are now three rollers in place of the original two, and this addition has been made without too serious a reduction in their diameter. The arrangement naturally improves the distribution of the pressure on the ground and ensures smoother travelling.

Each caterpillar track is supported on a long cast steel side beam or frame, which carries the driving sprocket, the idler roller, three track rollers, and the small supporting roller under the top belt of the caterpillar. The frames, which are cast in the form of an inverted U, protect the track rollers, adjusting screws, &c., from dirt which may be carried over with the caterpillar belt. Although the three supporting rollers are well protected against dirt falling from the caterpillar belt, they are nevertheless very accessible, and any one of them can be easily removed after travelling one end of the caterpillar track on to a block of timber until the portion of the track below the roller to be removed is slacked off.

Each of the caterpillar belts with its side frame, sprocket, rollers, &c., forms a complete unit. These units are carried on two dead axles which pass right through and cross the framing. By removing the chain wheels and the nuts from the ends of the long bolts which hold the two track frames in position on the main casting, the caterpillar units can be removed either with or without the track belt. All the weight of the superstructure is carried on the two "dead" axles which do not rotate. The short driving axles carry only the travelling load.

Some Reflections on Technical Education.*

By H. L. GUY.

Several generations have passed since technical education became effectively organised in this country, since a devoted band of inspired men roused this country from its lethargy to a lively sense of apprehension, if not of alarm, for the future of its trade and industry.

In every other industrial country the necessity for advanced technical education has passed beyond controversy, as did that of primary education.

National comparisons of average educational level of those engaged in industry bring small comfort to lovers of this country. They compel us to rely for the maintenance of our national position upon some inherent superiority in the man himself—surely an unsatisfactory, if not presumptuous, assumption. So whatever our mood, the game is played and the issue determined for us by other nations. Merely to hold the place of his predecessor, the recruit to engineering must needs have superior qualifications to his forerunner of a preceding generation.

By educational inflation the currency becomes debased; secondary education to-day has but the exchange value of primary education of thirty years ago; and the college or university standard now command only the respect formerly accorded to secondary education.

So far as the man is concerned, those individual qualities of character and personality must decide the issue if industry provides, or can be made, by the man to provide the opportunity. His educational and personal equipment finds effective play in exploiting that opportunity.

It may be held rightly that the man of extraordinary ability or exceptional strength of character will in any case command success without profound technical knowledge, but who will say that even he would not find success more easily, or success become more complete, if to the same natural ability and inherent strength of character he adds a mind trained and skilled in technical knowledge?

There appears still to be a large group of influential opinion in the councils of industry, which, while admitting the value of advanced technical training to the "specialist," "designer," or "expert," denies its necessity or usefulness to the large body of staff in supervisory executive and commercial positions.

It is just with these I join issue. Who doubts, who knows aught of foreign business, the success of the technically instructed commercial man or "salesman" in foreign countries or our own? Who that appreciates the growing tecnhical equipment and requirements of purchasers in this country will deny the advantage of adding technical grasp to commercial acumen.

Even to-day with many of the large buyers in this country an interview in furtherance of a business deal in which the man with the goods to sell is either unable to grasp the technical need to be met or to exploit fully the technical properties of his wares, is a futility to the seller and an annoyance to the purchaser.

So, too, with those whose business lies in the employment and direction of industry and of labour, those concerned with the manufacture of the article, which all agree must be designed by the technically highly skilled. The more complete the understanding by the works staff of the technical questions involved in the design and manufacture of modern engineering products, the more effective the production and the cheaper the article produced. Extensive technical knowledge and a trained mind are no handicap in a live workshop to-day.

* * * *

That the graduate will, in future, be required to man engineering thought cannot be successfully denied; the question would not arise in any country but this. Already in certain of the larger industrial organisations in this country the attainment of such a standard is the minimum qualification acceptable for those minor positions on the staff from which all higher office and opportunity extend.

The employer who is concerned with a complex engineering product, changing from year to year as a result of the changed demand and needs of users, and the study, experiment, and research of his competitors, can choose which of three courses he will follow:—

First, he may bring to his aid all the technical skill and enthusiasm his country can supply in the magnificent raw material turned out by our colleges, devote a due proportion of his income to experiment and development, and so improve his products and methods as to keep pace with his very live competitors.

Secondly, he can, recognising himself either failing in courage or competence to follow the first course, seek out someone who is not, making treaty with him to manufacture under licence, paying tribute on everything produced to the more enterprising and technically skilled manufacturer.

This latter was the course which found favour amongst some English engineering firms prior to the war, who, to the shame of their country, were rapidly converting their factories into mere workshops, making machinery to the design of others and selling it handicapped by a heavy tribute paid to those who chose to pursue the former plan.

Thirdly, he may hang on, doing nothing to keep abreast of changing times until an irate bank and the Official Receiver bring to an ignominious close a career marked by a pathetic and futile loyalty to the doctrines of a generation which is always the generation before the one before the last.

At present, industry as a whole has not made up its mind. It knows it is passing through stern and troublous times. It is aware of and fears the growing pressure of competition from countries which in most cases secured at least a long lead in the general employment of technical knowledge.

It may or may not be aware that each year an army of technically equipped men is turned out eager to take advantage of any opportunity to get right into engineering and to play an effective part.

It may not know what his foreign competitors do know—that these trained young men are second to none in the world. Foreign firms will readily employ the better placed technically trained English students, while many English firms have no place for them.

* * * *

I have often been impressed—and occasionally oppressed—by an apparent difference in the development of higher technical education in this country from that which is established in certain continental countries, of which I have some knowledge, and in the U.S.A.

In America, for instance, it is a frequent experience to find a professor of engineering becoming the chief engineer of a leading engineering concern or even founding one. Conversely, many of my friends, one-time chief engineers or leading designers in industrial firms, make a rapid transition to the professorial chairs of the leading engineering schools.

In Germany, Czechoslovakia, and Switzerland, many of the leading professors of engineering have close and continuous association with the most progressive manufacturing firms in their country.

They are thus in continuous association with the developments which are taking place, and being informed in this way of the problems which are arising, it is matter for small surprise that they are continuously contributing to the solution of those problems. Others have extensive practice as consulting engineers, one of my acquaintances dividing a long working day equally between the university and his private practice. In the branch of steam practice with which I am concerned, many of the continental contributions have come from the professorial study and the scholastic laboratory.

Further, the solution of many of the technical problems which arose in the rapid development of high-speed machinery were provided by professors who thus laid industry and civilisation under an obligation which both have done something to repay.

The last thought I want to suggest is that this record is indicative of a greater inventive, constructive, or analytical ability in the *personnel* of the teaching staff of foreign universities and colleges than our own.

Still less do I wish to suggest that these display greater energy and fixity of purpose than their English *confrères*. But I do feel it is indicative of a larger national vision in planning and of a more generous provision of staff which has rendered possible a greater, more intimate, and continuous contact between those engaged academically and the practising side of engineering.

Nothing could be more disastrous to the national interest than the gradual development of a system of scholastic engineering which shall by slow degrees lose touch with practising engineering, and ultimately in its final phase perhaps even acquire the same cultured exclusiveness and remoteness from living affairs as exist between the spoken and the dead languages.

The problem to which I direct your attention is that of, first, erecting a bridge between these two essential sides of engineering, and then of stimulating a two-way traffic of *personnel* as well as of ideas across it.

In other countries cases have come to my knowledge of the practice of some who occupy Chairs of Engineering of the highest distinction, entering the engineering offices of some of the chief factories during the long vacations and working with the engineers on some problem which is engaging the attention of the engineering staff and to which they can bring special knowledge and attainments.

I am not aware of such a practice being followed in this country.

On the other hand, some of my friends abroad who occupy the highest offices in industrial concerns are attached, with professional status, to the staff of the premier colleges in their neighbourhood, probably on a purely honorary basis, and as such are directly responsible for a short annual course of instruction to the senior students.

The advantages of these two kinds of association are two-fold. Like the quality of mercy, it is twice blessed, it blesseth him that gives and him that takes.

Practising engineering is enriched and assisted by contact with the latest developments in theory and the creative thought of the tutorial study; while the teaching of engineers is enriched by contact with the latest developments of practice and the creative thought exhibited in the invention and research of those engaged in industry.

I imagine that the desirability of achieving these results will be immediately conceded by everyone present.

The matter to which thought should be directed is that of finding means for achieving these ends.

The solution will be found most readily if we first define and limit the objective we desire to reach and then visualise the difficulties which lie between us and its realisation.

We are concerned with one or both of two complementary objectives—first, to establish more intimate, direct and contributing relationship between those practising engineering of proved capacity and standing in creative engineering and the teaching of engineering in our colleges and universities.

Secondly, to establish a more intimate and direct relationship between those of proved capacity for creative thought on the teaching staff of the colleges and universities and the practice of engineering in industry.

* * * *

If the practice were adopted under which a recognised authority on some phase of engineering practice became attached in an official and permanent way to the staff of our colleges in much the same way as eminent medical specialists are attached to our medical schools, I suggest a far more effective and productive alliance would have been made.

An official standing within the structure of the college would be essential, with the obligations and privileges which this implies.

Inevitably such a continuous and official association would result in the business associates and industrial circle in which the specialist lives being continuously supplied with first-hand knowledge of the *personnel* of the whole-time staff, their professional activities, their capacities for contribution and their actual contribution to engineering science.

On the other hand, the professional and social contact thus established between the specialist practising engineering and the permanent staff would naturally result in the transmission of information relating to the problems and trend of development in the field with which he is associated.

It may be suggested that the difficulty would lie in enlisting such active service from specialists who, of necessity, are extremely busy men. But I personally believe there are many who would respond from a sense of public duty stimulated by an equally lively sense, both of obligation to the cause of higher technical education to which they owe much, and of a realisation of the national advantage to be derived from the developing and sustaining a living and progressive engineering faculty.

This response is most likely to come from just those whose services would be of most value.

Co-operation would most easily be effected if the office were purely honorary. Those most competent to serve are usually adequately remunerated in their usual calling, so that such remuneration as could readily be afforded would in any case not be attractive as a compensation for the time and trouble which would be involved, and which would be willingly given in discharging the duty efficiently.

Cases occur to me where, in this country, all the essential conditions are present in their proper relationship, and where, if a considered scheme were elaborated, and an organised effort made, courses could be provided in particular branches of engineering technology which would command an authority without rival.

I may be told that this scheme has been tried and is even now applied.

But I take leave to doubt the assertion. We speak of different things. I ask leave to inquire whether the association was as intimate and continuous as I have postulated, and as appears to me essential if the all-important indirect advantages are to be secured.

* * * *

Gentlemen, I submit what I have said to you with all deference, all too-conscious that at best each of us sees but a few facets of the problem.

I do so, believing that a large measure of the future prosperity of our engineering industry lies in the continued development of an advancing technical knowledge appertaining to all its activities, and that the development of that knowledge is an obligation common both to the teacher and the practitioner of engineering.

I believe that its future will depend to a greater extent than is commonly appreciated on the development of a corps of supreme technicians for the services, both of our schools and all branches of industrial activity, and to that end let the base of the educational pyramid be as broad and all-embracing as can be conceived and constructed so that the all-important apex may be the better sustained.

* Excerpts from an address at the meeting of the Oxford Summer School, arranged by the Board of Education, July, 1931.

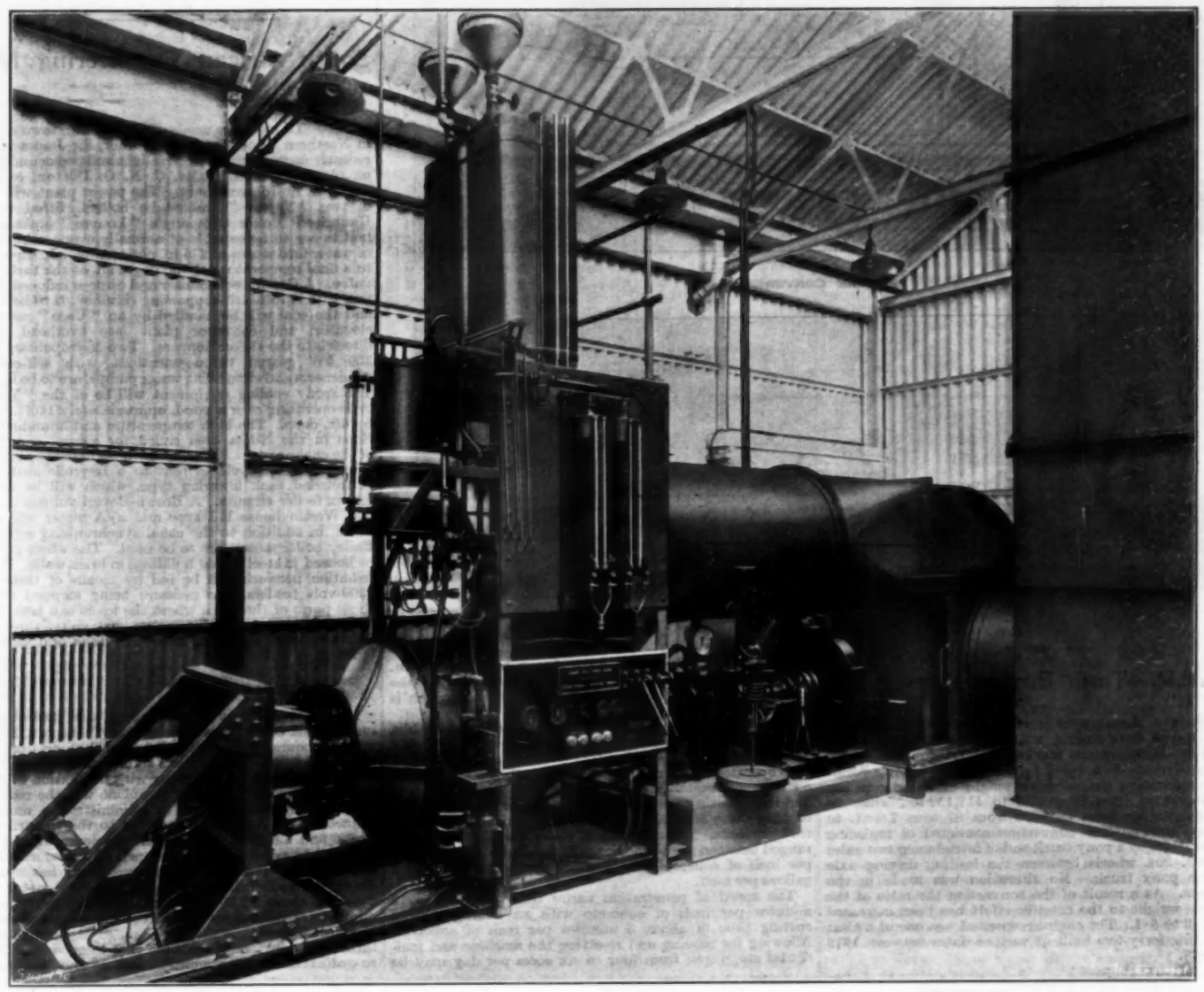
SIXTY YEARS AGO.

There must be those still living who knew and who have spoken to Mr. Charles Dyke, a veteran engineer of New York, whose death at the age of eighty-five we recorded in our issue of August 18th, 1871. Yet he was born about the time when Watt was inventing the parallel motion and when the Constitution of the United States was being hammered out at Annapolis. He probably heard or read of Lardner's offer to eat the boilers of any steamship that should safely cross the Atlantic, and, as a man approaching his prime, he could easily have been the companion of Lewis and Clarke in their exploratory expedition of appalling hardship from the frontier of the United States westwards to the Pacific. Yet he lived to see the establishment of a daily steamship service across the Atlantic and the building of a railway from the Atlantic to the Pacific. He survived a great fratricidal war in which the possession of steamships and locomotives had been a major factor controlling the issue. He had, in short, seen steam change the whole face of civilisation. Mr. Dyke did not live long enough to witness men flying, but from a paragraph in the same issue it is evident that he could have seen them "taking to the air." Had he gone to Detroit just before he died, he would have found Mr. Fulger of that city, with two spacious wings of rattan, cork, and oilskin, repairing to the roof of a one-storey house in the presence of newspaper reporters and an admiring group of friends. He would have heard Mr. Fulger, just before starting to flap his wings, telling his friends that he would telegraph back to them after he had reached Grand Rapids. And then he would have seen Mr. Fulger landing in a bed of weeds on a soft portion of his anatomy. He would have been relieved to find that Mr. Fulger was not seriously hurt, and as an engineer he would doubtlessly have been interested to learn that, according to Mr. Fulger, the mishap was caused by the fact that he had lost the centre of gravity. It was, of course, very foolish of Mr. Fulger to mislay this important item of his equipment. . . . From comedy, Mr. Dyke, in the closing days of his life, might have passed to tragedy. On July 30th, 1871, the ferry steamer "Westfield" left the Staten Island wharf with over 200 passengers on board. Most of them had gone forward for the sake of the breeze, and were standing right over the boiler-room. Just as the steamer cast off the boiler exploded. The deck was blown up and the smoke stack hurled into the air, but the vessel did not sink. Ninety-three people were killed. The cause of the disaster was traced to corrosion and cracking of the boiler plates, and to the fact that even when new the plates—for a pressure of 27 lb.—had been only about ¼in. thick. The news of the disaster may have been brought to the old man as he lay dying. Possibly the noise of the explosion may have been the last earthly sound which he heard. It was a grim farewell to one who, from the very same spot sixty-four years previously, on August 7th, 1807, had set forth as engineer in Fulton's "Claremont" on her historic first trip to Albany.

Seven of the oak pillars that support the roof of the Church of St. Matthias, Poplar, in London's dockland, are masts recovered from wrecks after the defeat of the Spanish Armada. The church was founded by the East India Company in 1654.

AERO-ENGINE TESTING PLANT

HEENAN AND FROUDE, LTD., WORCESTER, ENGINEERS



An Aero-Engine Testing Plant.

We recently had an opportunity of inspecting a new plant for testing aero-engines which has been installed at the works, at New Malden, Surrey, of British Salmson Aero Engines, Ltd., by Heenan and Froude, Ltd., of Worcester, and is illustrated by the half-tone engraving above. The plant is, in general principles, similar to that made by the same firm for the Indian Government for installation at Karachi, which was described in The Engineer of August 1st, 1930. It has, however, several peculiarities and is not quite of such a large capacity. It is, in fact, intended for testing radial engines of from 40 up to 250 brake horse-power, and is housed in a spacious building adjacent to, but partitioned off from, the erecting shops of the factory. It follows the usual Froude design, in which the power developed by the engine is absorbed and measured by a hydraulic brake, while the engine cylinders are kept cool by an artificial draught produced by a fan driven by a separate motor. There is also provided a separate electric motor for starting up the aero-engine. The various instruments necessary for testing the engine are permanently installed on the plant and are grouped together conveniently so that one man can carry through a test from a single station, and it is not necessary to rig up temporary supports for meters, manometers and the like.

The engine to be tested is bolted on to a casting attached to a steel framework, seen on the left of the illustration, which may be adjusted longitudinally with regard to the testing plant to suit the engine under test. It is noteworthy that the design of this framework is of no inconsiderable importance, as synchronous vibrations may be set up, unlike those possible when the engine is fixed in an aeroplane, that would spoil the test. As a consequence the frame has been made unusually rigid and is bolted down to a pair of channels embedded in the concrete floor. It is also noteworthy in this connection that an engine of 50 horse-power is held back to its foundation when in service by means of six bolts of 7 mm. diameter—an indication of assurance that vibrational troubles are insignificant in service.

When the engine is set up in the testing machine it is faced by the duct through which the artificial cooling blast for simulating its passage through the air is provided, and by a shaft connected with the dynamometer. There is a light tubular shaft with cardan joints to make the connection, but the arrangements made for the setting of the engine are such that its crankshaft and that of the dynamometer may be readily made concentric.

The dynamometer is of the standard Froude type and can be seen in the illustration below the raised part of the air duct. Its spring balance is arranged conveniently to the operating station. Beyond the dynamometer on the same line of shafting there is the electric motor used for starting up the aero-engine. There is a dog clutch for connecting the motor to the engine shaft, and we noticed that it has a peculiar hooked form of tooth devised to prevent accidental disengagement until the engine really does overrun the motor. The handle for engaging the clutch can be plainly seen in the engraving.

The fan for producing the artificial cooling draught is on the right, in the illustration, and is capable of producing a draught at the engine under test of 120 miles per hour, and at the maximum output requires 80 horse-power. It draws air through the tall duct, shown on the extreme right, which extends through the roof of the test house with the object of providing air as free of dust as is possible. The inlet to the fan is controlled by dampers so that the amount and speed of the air delivered may be under complete control.

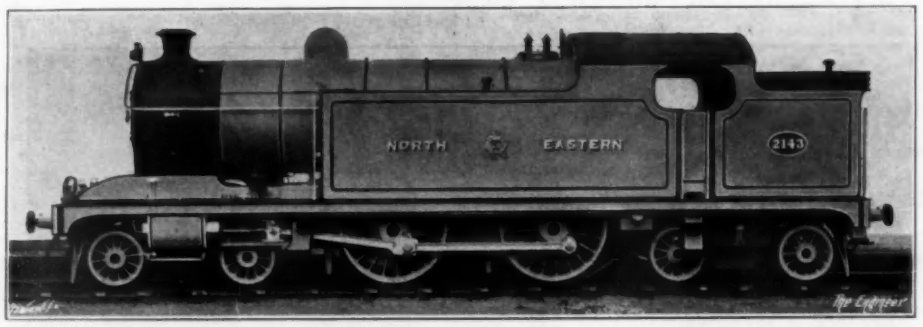
Arrangements are made for the convenient connection of the controls of the engine to levers permanently fixed on the instrument board, and there is provision for the circulation of the lubricating oil of the engine through a system in which it is both metered for quantity and temperature. The operation is effected in the dark-coloured tank shown on the side of the central standard. Above there are the two calibrated tanks for petrol, which are alternately filled from an outside storage. There are also Pitot tubes in the air duct to determine the speed of the draught supplied by the cooling fan. In fact, practically every feature of the performance of the engine, bar, perhaps, the qualities of the exhaust gases, can be determined at any moment by the test operator, and he can vary the conditions of loading without moving two paces.

THE USE OF WASHED COAL.

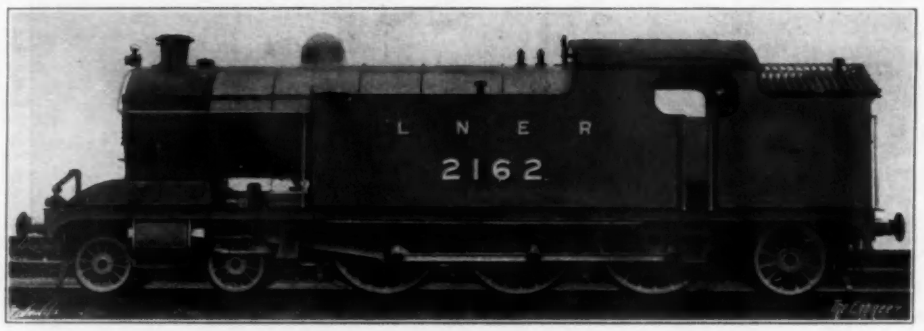
About 10 per cent. of the coal production of the United States is now cleaned for commercial and metallurgical uses, and of the amount 60 per cent. is cleaned by wet washing and 40 per cent. by dry cleaning. In a report made by Mr. Fieldner, engineer of the Bureau of Mines, it is explained in considering the use of washed coal, the gas or coke plant manager is concerned with the removal of slate, shale, bone, pyrites and other mineral constituents, and also with the effects of moisture in the coal. The removals are desirable, and the effects of moisture are mainly undesirable, although there are some desirable effects. For gas production, the elimination of free mineral impurities reduces the sulphur in the gas and results in a greater yield of gas and by-products per ton of coal charged. For coke production it reduces the ash and sulphur, reduces clinker troubles, reduces the breakage in handling, reduces the percentage of small coke and breeze, and gives greater uniformity in chemical composition and physical properties. Adverse effects due to moisture include reduction of oven capacity and output, owing to the lower density of moist coal and the longer coking time, higher fuel consumption per ton of coal carbonised, non-uniform coke owing to wet spots in the charge. Further, excessive or 12 to 15 per cent. moisture causes weak and large-celled coke, while coal that is dripping wet may cause spalling of the brick lining of the oven. On the other hand, moisture increases the ammonia yield and reduces carbon deposits on the oven walls. Its effect on gas, oil, and tar products has not been determined. As a general conclusion, it is held that to secure the most economical results, the moisture content should not exceed 4 or 5 per cent. Washed coal may be dried in order to increase capacity and reduce fuel consumption at the ovens. While this is expensive, it appears that it may be economical if it is not carried to an extreme, but leaves the coal with moisture about 2 or 3 per cent. above its normal content.

In Safety in Mines Research Board Paper No. 43, published in 1928, it was recorded that coal dust clouds carried in air currents generated sufficient electricity to enable sparks to be drawn from the containing vessel. In view of the use underground of auxiliary fans for ventilation purposes, the matter has been further investigated to ascertain whether electricity so generated is likely, under pit conditions, to involve any danger from the ingition of fire-damp. The experiments are described in the Board's Paper 71, "Spontaneous Electrification in Coal Dust Clouds," by S. G. Blacktin and H. Robinson, which may be obtained from H.M. Stationery Office, price 6d. It was found that high voltages could be produced on well-insulated metal tubes in which air currents carrying small concentrations of coal dust were passing at speeds ordinarily used in mining practice, and that sparks of sufficient energy content to ignite fire-damp could be drawn from apparatus so electrified. But a minute leakage to earth, such as normally obtains underground, or a single deliberate earth connection, is sufficient for complete elimination of this effect.

L.N.E.R. TANK ENGINE



BEFORE CONVERSION



AFTER CONVERSION

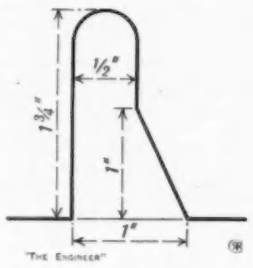
L.N.E.R.—Tank Engine Conversion.

In the two photographs reproduced above we illustrate a 4–4–4 type tank engine, which has recently been converted at the Darlington Works of the London and North-Eastern Railway to a 4–6–2 type locomotive. As a result of the conversion the adhesive weight of the engine has been increased from 89,488 lb. to 117,152 lb., while its total weight has been reduced from 87 tons 7 cwt. to 86 tons 18 cwt. The conversion consisted of replacing the rear bogie by a pony truck and of introducing two axles with 5ft. 9in. wheels between the leading driving axle and the pony truck. No alteration was made in the cylinders. As a result of the conversion the ratio of the adhesive weight to the tractive effort has been increased from 3·9 to 5·1. The engine converted was one of a class numbering forty-five built at various dates between 1913 and 1922.

Machine for Drilling Cores from Concrete Roads.

A machine has recently been supplied to the Ministry of Transport by Holman Brothers, of Camborne, Cornwall, for use at the research station at Harmondsworth and elsewhere for the purpose of drilling cores from concrete roads. It is illustrated by the accompanying engraving.

The machine has been constructed to operate as an independent trailer unit, the chassis being equipped with springs and rubber tires. At one end of the chassis there

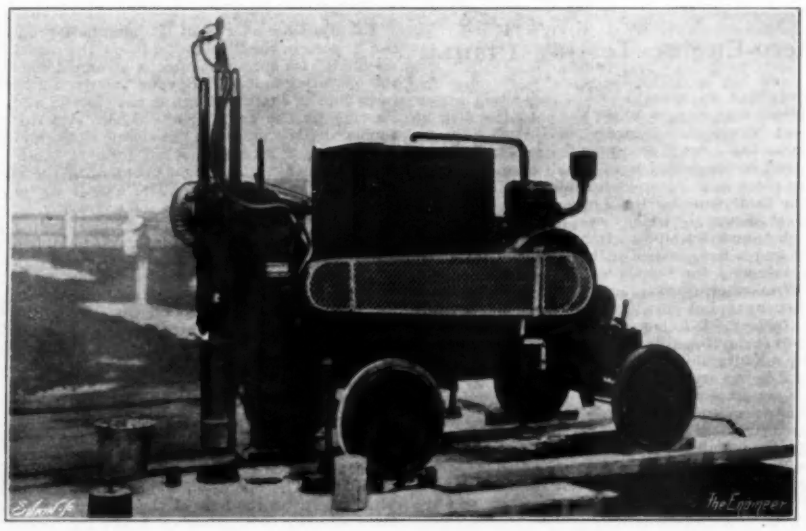


SLOT IN CUTTER EDGE

is a stiff vertical frame through which pass two guide rods braced together at top and bottom by steel forgings, and a central rotating hollow shaft or "quill." The lower end of the quill is fitted with a hollow cylinder, to the end of which is screwed a "crown" or cutter of 7¼in. external diameter and 6¼in. internal diameter and initially about 6in. long. In the lower edge of this crown there is cut a vertical slot ¼in. wide and 1¼in. high. The trailing corner of the slot is chamfered off, as shown in the sketch, to give an inclination of about 63 deg. The quill, with its crown, can be raised and lowered by a lever operating pinions, which engage with racks cut in the two guide rods. When in operation load is applied to the crown by loading this lever either by hand or by dead weights. The quill is rotated through reduction gearing, which is driven by belt transmission from a 6 H.P. Lister engine mounted at the other end of the chassis. In the middle of the chassis there is a tank of about 150 gallons capacity, which forms a reservoir for the circulating water for cooling the motor and feeding the cutter. Sufficient movement of the crown is permitted by the rack to allow a 15in. core to be cut, the actual cutting being effected by the grinding of the concrete with chilled steel shot which is fed under the crown.

Since the hardness of concrete varies considerably, it is impossible to state definitely what quantity of shot or water is required, or what time is necessary to cut cores. The operator must rely upon his experience in deciding on the most suitable weight to be applied to the crown and in regulating the flow of water, and must be prepared to vary these conditions as the drilling of any particular core proceeds. The quantity of water used for a core has ranged between such wide limits as 3 gallons and 12 gallons per inch of concrete, but a usual figure is from 5 to 8 gallons per inch.

The speed of penetration varies from about 3 to 13 minutes per inch of concrete with an average actual cutting time of about 5 minutes per inch of concrete. Allowing for moving and resetting the machine and incidental stoppages, from four to six cores per day may be drilled. The quantity of shot used may also vary between rather wide limits, but for an 8in. core it is generally from 6 lb. to 8 lb., of which about 50 per cent. is subsequently recovered by magnetic separation of the steel shot from the silt left at the bottom of the hole from which the core is drilled, which gives a net consumption of about 4 lb. of shot per core, or roughly ½ lb. of shot per inch depth of core. Experiments have shown that the machine is capable of cutting any but the very poorest concrete, and that sound concrete is easier to cut than open concrete, as the crown can be more heavily loaded in the former case. Normally reinforcement presents no obstacle to the cutting of the cores, but when the crown reaches the reinforcement it may cause the machine to chatter, and the load then has to be reduced so that the rate of penetration is decreased. If the reinforcement is well anchored in the concrete there is little difficulty, but when the reinforcement is only loosely held and the concrete is porous there is grave danger of the core breaking in the plane of the reinforcement. Very little experience has yet been gained in the cutting of asphalt, but so far it has been found that it takes as long to cut 2in. of asphalt as 6in. or 8in. of concrete, and in nearly every case the asphalt became separated from the concrete base during the process.



CONCRETE CORE DRILLING MACHINE

South African Engineering Notes.

Power for Ndola.

To meet the needs of the growing town of Ndola, in Northern Rhodesia, the Governor, Sir James Maxwell, recently sanctioned an electric light and power undertaking on plans prepared by Mr. C. N. O. Dutton, consulting engineer, of Johannesburg. The power plant will consist of two "Yarrow" water-tube boilers, fitted with the Underfeed Stoker Company's "Louvre" stokers. The boilers are to be capable of normally evaporating 7500 lb. of water into steam at 275 lb. per square inch, superheated to a final temperature of 750 deg. Fah. at the turbine stop valve. A Green's economiser and Sirocco induced draught fan, with a 75ft. self-supporting chimney, is to be erected, and the coal will be handled by an "Usco" mechanical elevator, and conveyor plant into overhead bunkers direct into the stoker hoppers. Two Metropolitan-Vickers 300 kW geared turbo-generators, with self-contained condensers and circulating water pumps, are to be installed. The spray cooling equipment will be of the "Yorway" type operating over a pond, approximately 140ft. by 50ft. by 4ft. deep. The high temperature and humidity conditions in the Ndola area called for special examination of the cooling plant. The generators will deliver 3300-volt, three-phase, 50-cycle current to a Reyrolle switchboard of ironclad tank lowering type, which will be arranged for six feeder circuits. A Brown-Boveri voltage regulator and Westinghouse R I type and kVA meter will also be fitted, in addition to the usual synchronising equipment. Bailey boiler meters are to be used. The whole plant will be housed in steel frame buildings in brick walls. The distribution network will be fed by means of three-phase, 3300-volt feeders, the pressure being stepped down in those parts of the town where the loads can best be met, to a low-tension distribution of 400 volts, three-phase, four-wire, with 230 volts between phases and neutral for lighting.

Aviation Control.

Government is discussing the desirability of making Mr. C. W. Malan Minister of Transport, Railways and Harbours, and adding the control of aviation to his department. When six years ago it was first found necessary to pass legislation dealing with navigation of the air, the conveyance of mails by aeroplane was the most practical task considered, and so administrative matters in connection with aviation were left to the Department of Posts and Telegraphs. Recent developments, however, have made aviation more a branch of transportation and less a purely Post Office matter. There has also been developed under railway management a road motor service covering about 12,000 miles of route and carrying large numbers of passengers and increasing quantities of farm produce. With air transport likely to expand in the near future, it is obviously desirable that there should be close co-ordination with the country's railway and road transport system. The erection of a mooring tower for airships and the necessary powers for controlling airship communication have been vested in the Department of Railways, and the handing over of all other matters concerning aviation to the same Minister is under discussion.

Steel Corporation Prospects.

At the annual meeting of shareholders of the Iron and Steel Corporation, the chairman, Dr. Van der Byl, in the course of a lengthy review, said that the prospects of substantial profits were exceedingly encouraging, even at the present price of steel. Thanks to the exceedingly low cost of production, which the Board was satisfied by experiment could now be attained at Pretoria, he estimated that on a production of 150,000 tons of steel per year there would be a gross profit of £765,000. The directors, he added, had never wavered in their confidence of success if the industry were carefully established and

well guided. Tests revealed that hematite iron ore on the Corporation's properties could be crushed and drilled easily, and that the reserves were so enormous—100 million tons—that most of the operations for many years would be open-cast or adit mining, so that the cost of mining would be relatively low. The ore would be landed at Pretoria at less than 10s. a ton, and a mixture of 80 per cent. of that hematite ore with 20 per cent. of the Pretoria ore would produce a pig iron at an exceedingly low cost. The estimated cost of producing pig iron was under 30s. a ton, while the latest quotations for the cheapest continental pig iron was 48s. a ton f.o.b. Antwerp. The imported ore fetched up to 127s. per ton on the Rand. Steel ingots would be produced at Pretoria at 51s. a ton, and the cost of converting the ingots into the products it is proposed to manufacture ranges from 14s. to 36s. 8d. per ton. The cost of landing corresponding products at Johannesburg, based on the lowest continental prices, ranges from £7 to £15 per ton. The opinion has been expressed locally that the foregoing resembles very much the roseate accounts one reads now and again in the prospectuses of more than usually speculative undertakings.

Japanese Electric Goods.

In consequence of an agreement entered into between the Government of the Union of South Africa and the Government of Japan, wholesale Japanese merchants are now permitted to have warehouses in all parts of the Union and have commercial establishments and carry on wholesale business or sell direct to the consumers. In consequence, Japanese goods are speedily ousting not only similar goods made in Britain and the Continent, but also those manufactured by Union factories. In some classes of goods, notably cheap shoes and cheap cotton goods, there have been increases of 4000 per cent. Last six months shows over half a million pairs of shoes imported from Japan, and the quantity is continually increasing, while factories here making a cheap grade of shoes are unable to cope with shoes that are selling at 1s. 6d. a pair, and in some cases less. Now a serious note of warning has been sounded with regard to the growing menace of competition from Japan in the electrical trade by Mr. H. P. Borlase, whose double *rôle* of Member of Parliament and director of one of Durban's oldest firms of electrical engineers and contractors, gives additional weight to what he says. Starting with small articles, such as shades, flexible wire, switches, globes, &c., principally through ubiquitous bazaars, this "peaceful penetration" has gone on to larger appliances, such as kettles and irons and to stoves and water heaters, and it is beginning to effect the local manufcaturers who already have the well-known makes of British, American, and continental stoves, &c., to compete with. This restriction of local production entails proportionately heavy manufacturing costs and consequently higher selling prices. Imports of such goods from Britain and the Continent will soon dwindle to nothing if the South African Government allows the present agreement to continue. Britain will be the greatest sufferer.

Cape Town Dock Extensions.

Work on the new southern basin of the Cape Town docks has now reached a stage which will permit of the first berth being put into commission at the modified South Arm. For this purpose the old South Arm has been widened to 700ft., entailing the deposit of 775,000 cubic yards of filling; 2¼ miles of railways have been laid on this reclaimed area, and shed accommodation, 500ft. long by 136ft. wide, has been provided for the new berth, which is 660ft. long, with a minimum depth of 25ft. at L.W.O.S.T. Work is still in progress on the completion of the second berth, which will be 760ft. long. When the whole of the modified South Arm is completed, approximately 4½ miles of storage sidings will be available, as well as 1½ miles of asphalted road. Total shed accommodation will amount to 120,000 square feet, and the whole area will be illuminated by floodlights. Adequate crane facilities, of course, will also be provided. The Random mole, which encloses the new basin on the south and south-east sides, is completed with the exception of the entrance head. The mole is over 1 mile long, and 263,000 tons of granite blocks, 180,000 tons of rubble and 150,000 tons of dredgings have been used in its construction. Dredging of the basin is in progress, and by the time this work is completed 1,250,000 yards of material will have been removed.

Durban's Bayside Railway.

The Government's intentions in connection with the railway along the Durban Bay Embankment have been officially announced, although no work will be done this year. The total estimated cost of the work is £183,434, of which a small portion will probably be spent during the current financial year. The estimates are:—Earthworks, £56,281; culverts, underground extensions, and boat ramp, £46,434; bridges, £22,000; electric or smokeless traction, £16,000; permanent way, £10,000; and jetties, yacht shelter, &c., £6184. Double tracks, composed of 80 lb. section rails, will be laid, the total distance being 1·6 miles. The advantages claimed for the new route include the saving of approximately 1 mile of haulage for all traffic by a direct run, clear of street level crossings on a double track permitting a two-way service and avoiding occasion for peak periods or rush clearances, a considerable reduction in shunting hours and engine power by the elimination of double or triple marshalling, with quicker turnover of trucks, simplified working in the Durban Central and Point yards, permitting a redesigning of lay-outs with increased accommodation facilities under safer working conditions, the saving of the cost of obtaining additional marshalling area at the Point—over £20,000—and of expensive alternative schemes, such as bridges, subways, duplication of present track, &c., and the recovery of much traffic now carted privately by road. The ultimate concentration of practically all shunting and marshalling at the new yard at Congella is estimated to effect a direct annual saving of £10,630 in enginemen, shunters and supervision, £2175 in engine power, and £2025 in signalling and crossing attendance, &c., or £14,480 in all.

An Electrically-Operated Farm Pump.

In our account of the exhibits at the Royal Agricultural Society's Show at Warwick, we referred to the all-round utility of the "Law" portable electric motor for farm purposes, and mentioned an application of this motor to the operation of a handle pump on a farm in Leicestershire. We are now enabled to give an illustration of this unusual combination of the old with the new in pumping mechanism. The motor shown is of the repulsion-induction type, and can therefore be started from rest against a full load. It is wound to operate on single-phase alternating current, and weighs 60 lb. The crank attachment was made by a local blacksmith. The support is a tubular steel tripod with a lever adjustment for regulating the height for alignment purposes. At the driving end of the motor there is a triple train of reduction gearing, and the gear shaft is coupled directly by a sleeve to the shaft of the machine to be driven. A hand wheel at the other end of the motor serves as a starter, a speed controller, and a direction reverser. To start the motor the flexible cable is plugged into an earthed socket, and the apparatus is steadied by the operator placing his foot on a step on the tripod. The hand wheel is then pressed in against a spring

ELECTRIC MOTOR DRIVING A FARM PUMP

to make contact, and is turned in the direction of rotation required. To increase the speed the handle is turned further in the same direction, the range being from 0 to 200 revolutions per minute. To stop the motor, the hand wheel is turned to a zero mark, at which point the spring automatically breaks contact. The pump shown is capable of dealing with 400 gallons of water per hour, and the maximum power consumption is given as 400 watts. It is being put on the market by J. Harrison and Co. (Liverpool), Ltd., Cunard Building, Liverpool.

CANADIAN NATIONAL RAILWAY TEN-YEAR RECORD.

To mark the tenth anniversary of the inception of a process which changed it from a collection of run-down and disconnected lines into one of the largest railway systems in America, the Canadian National Railways has issued a summary of its advances in that time. According to this summary, a large part of the system was barely out of the construction stage in 1920. Of all mileage, 41 per cent. was less than ten years old and 53 per cent. was less than fifteen years old. There was a plethora of main lines and a lack of feeders. This has been remedied by co-ordination and by branch line construction. In 1920 there were only 2 miles of feeders per mile of main line, while at the close of 1930 the figure had risen to 3¼. That had been accomplished by the construction of 1214 miles of branches and by co-ordination, including the abandonment of duplicating main lines to the extent of 225 miles and the reduction of other main lines to feeders.

The freight car equipment, as it existed in 1922, presented a special problem. Nearly all freight cars were of wooden construction, a type unfitted for movement in long trains, and considered so obsolete as to be denied interchange privileges subsequent to January 1st, 1931. The problem was solved, partly, by remodelling the better wooden cars, and partly by a vigorous policy of scrapping the older types. Since 1922 nearly 50,000 cars have been equipped with improved draught gear and 28,035 cars have been scrapped. The locomotive equipment in 1920 consisted of 3316 engines. The average locomotive could exert a pull of 32,250 lb. In 1930 the equipment consisted of 3096 engines, and the average unit could exert a pull of 38,500 lb. Since 1922 551 locomotives have been scrapped at a cost chargeable to operation of 7,288,886 dollars, and 406 new locomotives have been purchased at a capital cost of 31,714,537 dollars.

THE exhibition ship "British Exhibitor," which is shortly to make a propagandist voyage to South America, is being fitted up with a 100-line Strowger automatic telephone exchange by the Automatic Telephone Manufacturing Company, Ltd., of Liverpool. This network will be connected up with the local shore exchanges at the ports where the vessel calls.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Back to Work.

AT most of the works in the Midlands and Staffordshire work has now been resumed after the mid-summer break. There are, however, some establishments still idle owing to lack of orders. Since the recommencement, industrialists, whether producers of iron and steel or consumers of these materials, have been taking stock of the situation, and it has to be admitted that the outlook in most cases is not rosy. There has been some little accumulation of business during the past week, but it is of no magnitude and will be cleared off in a week or two without much difficulty. There are no evidences of any general improvement in trade, consumptive demand being at a low ebb. Those manufacturers who had hoped for a freer buying movement after the holidays have so far been disappointed, and the orders placed have been for small supplies required for immediate needs. There has hardly been sufficient market activity in Birmingham to test iron and steel values, and quotations generally stand where they were before the holidays. Hopes are expressed that the depression will lift in the autumn. August is notably a dull month in this area, but business normally begins to mend about the middle of September, and it is to this time manufacturers are now looking forward. All classes of industrialists will welcome improvement when it comes, and most of them are prepared to take full advantage of it. Plant has been overhauled and, in many instances, improved, and everything is in readiness for the much-desired trade revival.

Dearth of Steel Specifications.

In the heavy steel trade in this area there is a great scarcity of specifications for immediate delivery, and steel works have few contracts on their books. Midland structural engineering establishments continue employed on small contracts taken, in many instances, at cut prices owing to severe competition resulting from the general shortness of work. There are very few large-scale contracts in hand, nor are there many on offer just now. Indeed, engineers hereabouts are not cheered by the prospects, for they can discern little signs of expansion in the autumn. Steelmasters who have other outlets are anticipating an improvement in demand at latest towards the end of the year, but they have little, if anything, tangible to go on. Some steel is being called for on behalf of the electrical engineering trades, but it is not keeping up to recent levels. For some months past this branch of industry appeared to be unaffected by the general trade depression, but orders have fallen away during recent weeks and there has been some shortage of work at the big establishments in Birmingham and district. Automobile engineers' demands are also becoming less regular, even for special steels, and the decline in this branch is likely to become more marked as the automobile season draws to a close. Structural steel is protected in large measure by the rebate scheme, with which most of the large consumers here are associated; but in some quarters there is dissatisfaction at the range of prices ruling at date. Firms using foreign material are said to have a decided advantage when competing for contracts. Quotations this week in Birmingham for British material have all been on the Association basis. Angles are £8 7s. 6d., tees £9 7s. 6d., joists £8 15s., and ship, bridge and tank plates £8 17s. 6d., all per ton and subject to their respective rebates. There is little activity in the re-rolled and semi-finished departments, and no lessening of the severe competition from the Continent. Staffordshire re-rollers are no better employed than they have been of recent months. This is causing some of them to shade the recognised selling prices. Although the general quotation for small bars re-rolled from foreign raw material remains at £9 7s. 6d. to £9 10s., it is reported that orders can be placed at below these figures. For all British bars the minimum appears to be £7 per ton. Mild steel billets command £5 upwards, and Staffordshire hoops £9 10s. There is little activity in either strips or scrap.

Staffordshire Bars.

There are no developments in the Staffordshire finished iron trade. Business is quiet in all departments and values are substantially unaltered. The marked bar mills recommenced on Monday, but in the common bar branch some works are still idle. There is a regular call for best grade iron, but tonnages are light and makers cannot see far ahead. Selling prices are steady at £12 per ton at makers' works, ironmasters contending that there is nothing to be gained by any lowering of prices. Merchant bars vary in price from £9 5s. to round about £10 5s. The former figure would not be accepted by many Staffordshire makers, but competitors from other areas are quite prepared to do business at that figure. This competition from outside sources is of considerable moment to local makers, who claim that their production is of superior quality and, consequently, worth a higher price than that of competitors. Consumers are, however, buying in the cheapest market and a good deal of the business transacted goes outside this district. Common bars for the nut and bolt and fencing trades are almost a drug on the market. Producers maintain their quotation of £8 7s. 6s. in the knowledge that they cannot bring their price down to anything like the level of Belgian competitors. The great part of the material being made up in Black Country works is of foreign origin, and there seems little prospect of district makers securing a larger share of the business. Wrought iron gas tube strip is in moderately good request at £10 12s. 6d., but the mills could do with a good deal more business.

Raw Iron Demand.

A slightly better tone characterises the Midland raw iron market, and several blast-furnacemen report improved buying. It may be that consumers ran right out of iron before the holidays, and had to obtain fresh

supplies upon resuming operations. This is, to some extent, borne out by the fact that almost immediate delivery is requested with the majority of orders. It is certainly too early to read into this small accession of business any general improvement in consumptive demand. Indeed, it is almost expected that next week will witness a return to pre-holiday conditions. Furnaces having worked continuously throughout the holidays there is naturally plenty of pig iron on offer and orders can be met out of stocks. Derbyshire, Northamptonshire and North Staffordshire smelters all adhere rigidly to the selling prices fixed by the Central Pig Iron Producers' Association, and protest, as many users do, they have to pay these figures. Derbyshire No. 3 foundry iron is £3 6s., forge £3 1s., Northamptonshire No. 3 foundry £3 2s. 6d., forge £2 17s. 6d., and North Staffordshire foundry £3 6s., forge £3 1s. There is a rebate to consumers of large quantities. Furnacemen have ample supplies of relatively cheap fuel at their command, and were output larger a lower range of iron prices might be possible. As it is production is said to leave only a small margin of profit with iron at current selling rates.

Galvanised Sheets.

Galvanised sheet mills in this district are better off for work than they were, but competition prevents better prices being made. Though the figure of £9 7s. 6d. is being accepted for 24-gauge galvanised corrugated sheets, it is held to be unremunerative and quite a number of mills quote £9 10s. upward. Consumers point to the cheapness of spelter, and decline in many instances to pay more than the recent minimum, and as mills have no great reserve of orders they reluctantly accept the price offered. The home demand remains steady, and there is a little more movement in overseas markets. Tonnages are, however, light when compared with what they once were, and mills are not easily able to maintain uninterrupted rolling. Black sheets are in fair call and values show no change.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Unified Control in the Coal Industry.

IT is understood here that unified control of the coal-mining industry in Lancashire and Cheshire is approved of by about 80 per cent. of the owners concerned. The owners in the Lancashire and Cheshire fields have already formulated a scheme which is expected to be in line with the recommendations of the Coal Mines Reorganisation Committee. A development in the dispute between coalowners in this part of the country and the Lancashire and Cheshire Miners' Federation, regarding the question of increased rates of pay for operating coal-cutting machinery, is indicated in the announcement made within the last few days that the joint wages and hours board will meet in Manchester on Monday of next week to consider the appointment of an independent chairman, in order that a settlement may be reached. The Federation is asking for increased pay on the ground that the men engaged on such machinery have to do a greater amount of work.

Petrol-Driven Coaches and Trailers.

The English Electric Company, Ltd., Preston, which is working on a contract for the supply of six petrol-driven railway passenger coaches and trailers for shipment to Bermuda, has carried out successful trials at Preston on the dock railway, and it is expected that half of the contract will be shipped from Liverpool towards the end of next week.

Industrial News.

An improved outlook compared with a year ago was indicated by the chairman, Mr. R. C. Irwin, at the annual meeting of Edward Wood and Co., Ltd., constructional engineers, of the Ocean Ironworks, Manchester. The past financial year has not been a satisfactory one, for the turnover was one-third less than that of the previous twelve months. Since the middle of June, however, the works have been on full time, and future prospects are regarded as more promising. A statement issued by the directors of Crossley Brothers, Ltd., engineers, of Openshaw, Manchester, expresses regret that under present trading and financial conditions they are unable to recommend any payment on account of the dividend on the preference shares.

Non-ferrous Metals.

The demand for the non-ferrous metals during the past week has obviously been adversely influenced by holiday conditions, though this factor does not account for the whole of the quietness experienced in most sections, nor for the fresh weakness which has developed in respect of all of the metals, with the exception of tin. So far as tin is concerned, quotations are higher on balance to the extent of about 15s. a ton. This appears to be directly attributable to a slight improvement in the statistical position caused by the more intensive restriction of output recently decided upon. Buying interest in the metal, however, is not very much keener than it has been for some time. Copper is still distinctly dull, and with production undoubtedly top-heavy in relation to the demand, users here, and in most other centres, seem to be doing little more than meeting early needs. The market is easy and uncertain, and the past week's decline has brought prices to new low records. A fall of 10s. a ton compared with a week ago has been a severe setback to lead, and continued cautious buying is a natural result. Spelter is a shilling or two cheaper on balance, and poor aggregate sales have been reported.

Iron and Steel.

The iron and steel markets here have not been quite so dull as they were last week, but the movement of the majority of materials, as it generally is in August, is slower than usual. Few fresh orders have been reported in the case of pig iron, and deliveries against old commitments are not satisfactory. The latter, however, may be expected to attain better proportions, as the annual holidays in Lancashire industrial centres come to an end. Quotations are steady at 67s. per ton, delivered equal to Manchester, for Staffordshire, Derbyshire, and Cleveland foundry iron, 65s. 6d. for Northamptonshire, from 87s. to 87s. 6d. for Scottish, and about 81s. for West Coast hematite. Bar iron keeps up at £9 15s. for Lancashire Crown quality material and £8 5s. for seconds, but the demand in this section, as it has been for some considerable time, is decidedly poor. There are few bright spots in the steel market, and the demand for both British and continental products on this centre is decidedly poor, with current orders limited to small parcels for early delivery. Quotations for home-produced products are on much the same bases as before, but with the re-entry of German producers in the market, values of imported iron and steel have latterly undergone further decided weakness, wire rods being about the sole exception.

BARROW-IN-FURNESS.

Hematite.

The position in the hematite pig iron market is unaltered, and makers are still hoping for an improvement. In some cases stocks have accumulated to a considerable amount, and unless business shows an early increase, it will mean damping down. One may expect to hear of such stoppages any time now, unless there is a change. The amount of business done at present is small, and none of the buyers are inclined to place orders for forward delivery. The present price should tempt speculators, who could buy at a price which cannot come down any further, and which will, as soon as trade improves, rise. Foreign trade is slack. The iron ore trade is dull in both native and foreign sorts, and is likely to be until there is more life in the market. The steel trade is quiet. A few orders are spoken about, but no mills have been restarted yet.

Shipbuilding and Engineering.

The Portuguese orders which Vickers-Armstrongs have secured have already been mentioned, but the contracts are now fixed. Vickers will do no shipbuilding, their part of the order being confined to armaments. This big contract was secured in the face of very keen competition. Some changes are announced in the Naval Construction Works of Vickers-Armstrongs. Mr. George W. Barr, who has been manager of the shipbuilding side, has resigned. Mr. J. Callander has been appointed general manager of all departments of the Barrow works, responsible to the managing director, Commander C. W. Craven, R.N. Mr. W. H. Johnson has been appointed works manager of all engineering departments. Vickers-Armstrongs have received from the Great Western Railway Company an order for the supply of two pairs of steel lock gates for the inner lock of the Roath Dock, also for the hydraulic operating machinery for the gates. The contract covers the removal of the existing gates. The gates will be constructed at Barrow and the machinery at the firm's Elswick Works, at Newcastle.

SHEFFIELD.

(From our own Correspondent.)

Steel Production Still Low.

ALTHOUGH there was some increase in the output of open-hearth steel in this district for a few weeks before the holiday, a falling off has now taken place. The improved business was in the nature of a spurt in anticipation of the holiday suspension, and there is no sign of any general revival. At the Templeborough works of the United Steel Companies, where it was found possible, for a short time, to work seven furnaces out of the fourteen as against five previously, the number has now dropped to six. Ordering is still largely on a hand-to-mouth basis, and inquiries for bulk supplies are not forthcoming. There is no change to report in the Lincolnshire position. At Frodingham, the furnaces are still idle, and the steel for the works is being supplied from the Appleby plant. Nothing is being done towards a resumption of work at Redbourne Hill.

Steel Output in June.

Statistics are now available with regard to the production of steel in June, and they bear out the weekly reports as to the slackness of trade. In the Sheffield area, the output of ingots and castings showed a further fall, being 56,800 tons, as compared with 63,500 tons in May and 65,200 tons in June last year. Included in the total were 19,900 tons of acid and 29,900 tons of basic steel. Lincolnshire recorded a slight gain as compared with May, the respective figures being 36,200 tons and 32,800 tons; but there was a big loss from the previous June, when the figure was 61,500 tons. The returns of outputs for the first half of this year are equally disappointing. Production in the Sheffield area fell from 555,600 tons in the first half of 1930 to 384,500 tons, while in Lincolnshire the decline was from 400,000 tons to 198,106 tons. The production of pig iron—nearly all basic—in Lincolnshire in June was 34,300 tons, as compared with 35,100 tons in May and 68,000 tons in June last year.

The General Position.

Trade is bad at all classes of rolling mills, and the demand for both rods and sheets shows a declining tendency. In shipbuilding and railway material, depression is acute. The tire, axle and spring departments are running much below capacity, and both home and oversea railway companies are placing orders very sparingly. The hopes of obtaining large contracts for the Chinese railways, in connection with the distribution of the Boxer Indemnity Fund, have been deferred again and again, and are not yet realised. It is considered likely that Sheffield will obtain a good deal of work in supplying wagon springs, but whether the city will receive any orders for tires and axles depends on which firm secures the wagon contract. If this is obtained by one of the firms in the English Steel Corporation group, the tires and axles will be rolled at Trafford Park. Much disappointment is expressed at the placing of a big South African contract for steel sleepers in Belgium and France. In ordinary lines of steel commodities, buying is on a hand-to-mouth scale. The special departments are better employed, but few of them are flourishing. Heat-resisting steel continues in good demand, and there is also a large output of stainless and corrosion-resisting steels. The demands of the automobile builders for forgings, pressings and alloy steel for wearing parts, are still much below the level of a couple of years ago. The home trade in wire has been holding its own for some months, and exceeds the monthly average for last year.

Warships for Portugal.

Two small warships for Portugal are being built in this country, and the armament equipment for them is to be supplied by Vickers-Armstrongs, Ltd., who have signed a contract with the Portuguese Government amounting to £796,000. The total amount of the contracts for the ships and armaments is nearly £2,000,000, and all the work will be done in this country. Sheffield will be among the places to receive benefit from the contract, as Vickers-Armstrongs will distribute the heavier work between their factories at that place, Barrow-in-Furness and on the Tyne. The light armaments and some of the other work will go to factories at Erith, Crayford and Dartford. The work will be spread over about two years. Sir Herbert Lawrence, the chairman of Vickers-Armstrongs, states that they got the contract in the face of very severe competition indeed. "We went very near the bone," he says; "in fact, in arriving at our tender we took considerable risk."

Cutlery and Plate.

A few firms in the cutlery and plate trades are doing substantial business, but conditions generally are very poor, and there is a growing tendency to cut prices. Hotels and restaurants are good buyers of table ware of high quality, and a fair trade of the same kind is done with shipping companies, though orders from that source are below the average. While there is a steady call for pen and pocket cutlery of the best class, and also for presentation cabinets of cutlery, it does not represent any large volume of trade. Trade with most of the Colonies is quiet, or at best moderate, but a revival of buying is expected in the autumn, as stocks have got very low. Sheffield is now doing a useful trade in salad servers, fruit spoons, teaspoons, forks and other articles made from an aluminium-copper alloy which bears a striking resemblance to gold. Although not described as stainless, the alloy is corrosion-resisting. It is not applicable to the manufacture of knives. The price of the articles made from it is approximately the same as in the case of nickel silver.

Municipal and Other Schemes.

Pontefract Corporation is proposing to sink a second 36in. bore-hole at its new Eggborough waterworks, and has decided to make fresh application to the Ministry of Health for sanction to borrow £5000 for the purpose. It has accepted tenders for the provision of duplicate sets of pumps at a cost of £11,326 and £8574 respectively, and is to proceed forthwith with the erection of a house to accommodate the machinery. At Lincoln, the City Council proposes to reconstruct its gasworks at Bracebridge, and, pending the Ministry inquiry, has adopted a recommendation to accept the tender of Newton, Chambers and Co., Ltd., of Thorncliffe, for the supply of plant. Shardlow Rural Council has a scheme for new sewage works at Spondon, near Derby, to cost £10,000. A new fish market has been opened at St. Andrew's Dock, Hull, to replace the market which was destroyed by fire two years ago. It has been built by the staff of the chief engineer for docks of the L.N.E.R. Company, the owners, and is 1400ft. long and 90ft. wide. The main structure is of steel. The sides, roof and end walls are of fireproof material, and the floors of reinforced concrete.

NORTH OF ENGLAND.

(From our own Correspondent.)

Naval Work for Tyneside.

TYNESIDE will reap rich benefits from the order which Vickers-Armstrongs, Ltd., have secured in face of world-wide competition for the supply of naval armaments to the Portuguese Government. The contract is in the neighbourhood of a million pounds, and Tyneside's share will comprise the heavier work to be done at the firm's Elswick establishment. The two ships for which the armaments are to be made are also to be built by a British firm. This, of course, is good news for the steel industry. The naval work at Elswick is to be started upon within a few months, and will be spread over two years. Another encouraging contract placed this week is that for a 9000-ton cargo ship with Hawthorn, Leslie and Co., Ltd., the Tyneside shipbuilders and engineers, by J. and C. Harrison, Ltd. The North-Eastern Marine Engineering Company, Ltd., Wallsend, has obtained the contract for repairs to the machinery of the motor ship "Wellfield," which was salved in the Black Sea after being ashore for several months. The contract for the extensive repair of the hull of the vessel is still pending, but it is believed that this work is practically certain to be done by a Tyneside firm.

Iron and Steel Trade Conditions.

Unsatisfactory accounts continue to be given of nearly all sections of the iron and steel trade, the one outstanding exception being the constructional steel branch, in which producers have contracts made that will keep them employed for a considerable time. In many departments work is urgently needed to keep plant running, but producers are as unwilling as ever to yield to consumers'

efforts to obtain price concessions, protesting that costs prohibit a reduction of quotations. The depressed state of the industry is reflected in the decision of Dorman, Long and Co., Ltd., to lay idle virtually 75 per cent. of their plant throughout the whole of next week, when the Tees-side area takes its annual holiday. It has usually been the custom for only the steel works and rolling mills to cease operations, but owing to the lack of orders for pig iron and to prevent accumulations, the firm intends to damp down seven of its nine blast-furnaces, work being continued by means of two furnaces at Grangetown. In past years the Cleveland ironstone mines have been partially employed during the holiday week, but this year they are to be closed down for the full week.

Cleveland Iron Trade.

The general tone of the Cleveland iron trade is deadly dull, and signs of an early change for the better are as difficult as ever to discover. Export orders are almost unobtainable, and merchants being precluded from selling to Scotland or even to the bigger consumers in this district, such few sales as are negotiated are nearly all arranged direct from the works to the consumer. Generally, however, the demand falls short of production, and the stoppage of blast-furnaces next week is an indication of the determination of the makers to avoid further accumulations, if possible. Prices are still unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite pig iron prices are still inclined to droop, and even small lots are now obtainable on the basis of 61s. for mixed numbers and 61s. 6d. for No. 1 quality. Stocks of hematite are considerable, and continue to increase.

Ironmaking Materials.

The foreign ore trade is almost wholly idle, although prompt lots can be bought on the basis of 14s. for best Rubio ore, c.i.f. Tees. The coke market is firmer, but buyers claim to be able to purchase blast-furnace grades at 15s., delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is slack, only small orders being placed at present. All prices are unchanged.

The Coal Trade.

Conditions in the Northern coal trade show little change from last week, and new business is offered sparingly. The outlook for the next few weeks is disappointing, and gives no sign of any expansion in the demand. The cold weather spell has not had time to make any appreciable increase in the demand, and consequently the production is kept down by short-time working at numerous mines. In several districts there is idle time, owing to the owners having sold their full quota for the month. Best Northumberland steams are moving freely, and it is expected that present output will be maintained for the next week or two. Prices are steady, but unchanged, large at 13s. 6d. to 13s. 9d., and smalls at 8s. 6d. There is very little inquiry circulating for autumn shipment, and consumers abroad show no inclination to negotiate for next year's supplies. Tyne prime large coals are quoted steady at 12s. 9d. and small at 9s. Business in Durham gas coal is virtually limited to requirements under old contracts. The large gasworks contractors are not increasing their shipments, and the outlook for some weeks ahead is discouraging. Best gas qualities are plentifully offered at 14s. 6d., and merchants find no difficulty in securing the prime Wear gas kinds at 15s. Durham coking unscreened are offered at 13s. 3d. For bunkering purposes demand for the coaling stations is only moderate, but there is a fairly good demand for ships' use at North-East Coast ports. Best unscreened are steady at 13s. 6d. to 13s. 9d., and ordinary are weak at 13s. The coke market remains fairly active, but there are ample supplies, and makers cannot enforce any appreciation in prices. Best gas coke is well taken up, and the current production is earmarked. Stocks are considerable, prices being unchanged at 18s. Patent oven coke stocks are heavy, but the improved demand keeps prices steady at 15s. 6d. to 16s. Superior foundry coke is unchanged at 17s. to 20s.

SCOTLAND.

(From our own Correspondent.)

Subdued Markets.

On the whole the Scottish steel, iron and coal markets continue in a most subdued state. Home outlets, as a rule, are most restricted, and overseas business is spasmodic.

Steel.

With the shipbuilding industry working far below normal, the demand for steel shows little sign of expansion, and mills are, generally, working far below capacity, specifications for plates and sections being especially slow. Black sheets have, perhaps, just a shade more inquiry, but galvanised descriptions are not showing the slightest improvement. Tube makers are similarly placed, employment at the works being intermittent.

Iron.

The accumulation of orders during the holiday period was not sufficient to provide a good restart at the ironworks, and conditions are, more or less, similar to those pertaining prior to the stoppage. Bar iron makes little or no headway. Home prices remain fixed on the basis of £10 5s. per ton for "crown" bars, but, in all probability, the export quotation of £9 15s. per ton could be shaded if a good order was in prospect. There have been a few inquiries for re-rolled steel bars with the price round about £6 per ton home or export.

Pig Iron.

At the moment there is only one pig iron furnace in operation in Scotland. Just prior to the holidays five furnaces were damped down owing to the lack of demand, and they have not yet been put into commission. Only very small amounts are being inquired for, and as fairly substantial quantities still arrive in this district from the Continent and India, stocks held locally are ample to meet all demands. Last week 107 tons (61 tons foreign) were shipped from the Clyde, compared with 409 tons (373 tons foreign) in the same week last year. Prices are unchanged.

Coal.

Though an agreement has been reached on the wages question, the coal market still shows an unsettled tendency and business is still extremely difficult. Home requirements are not increasing and exporters do not find it any easier to do business ahead. Trade on the whole is of a hand-to-mouth character. Most descriptions of large coal are plentiful and the only qualities showing strength are treble and double nuts. Shipments amounted to 169,957 tons, against 155,760 in the preceding week, and 234,348 tons in the same week last year.

Miners Stop Work.

The institution of the lower scale of wages has not passed without causing trouble. In the Lothians district nearly a thousand miners stopped work because the surface workers refused to accept reductions in wages. A stoppage on a smaller scale also occurred in Lanarkshire.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

Featureless conditions have been mainly in evidence so far as the steam coal trade is concerned during the past week or so, and at the best they have not been satisfactory. It was, of course, expected that shipments last week would be prejudicially affected by the holidays, but it must be admitted that the figures turned out to be most disappointing. According to the returns issued by the Great Western Railway Company, which embrace the six docks in this area under its control, and, of course, include anthracite as well as steam coals, the total only came to 259,130 tons, which compared with 447,830 tons for the preceding week and was less by 56,057 tons than the total for the corresponding period of last year. So far this year the quantity of coal and coke exported amounts to 13,064,360 tons, as against 17,334,602 tons for the previous year, there being therefore a reduction of 4,270,242 tons. The figures for the current week should unquestionably mark an improvement, as a number of pits which did not work at all last week resumed on Monday, and the tonnage position has displayed expansion. At the end of last week the number of idle tipping appliances at the various docks came down to twenty-four, while on Monday this total was reduced to thirteen, while there were eleven steamers waiting to get into berth, nine of the latter being at Swansea. As a result, shipments have been brisker, but it is not well to expect this activity to last for long. Unfortunately, the amount of chartering is restricted, and there is not sufficient business about to justify the expectations that really busy conditions will continue for any length of time. The general inquiry from abroad is very meagre, and the bulk of shipments being effected are on old contracts. The Palestine Railways are in the market for 7000 to 8500 tons of large steam coals, for which tenders have to go in on the 18th inst., but, apart from that, there is no outstanding inquiry on the market.

Coal Exports to France.

Since writing last week, it has become known that the position, so far as shipments to France this month are concerned, is slightly more favourable than was at one time thought. Following upon the deputation from this country seeing the French Prime Minister on the question of some concession being granted to this country under the operation of the French import licensing scheme, it was announced that this country would be entitled to ship to France during August a total quantity of coal equal to the average exports in the corresponding month in 1928, 1929 and 1930. This, of course, was not considered to be very good, inasmuch as it was realised that shipments during August are generally below those of any other month in the year; but it is now authoritatively stated that the assurance given by the French Prime Minister was that this country would be entitled to export, during the current month, a quantity equal to the monthly average during the three years above-mentioned. The effect of that is that, if South Wales gets its full proportion of shipments to France, as compared with those for the whole of this country, this district will benefit to the extent of between 40,000 and 50,000 tons this month. It is understood that exporters are making the most of their opportunity to carry out shipments to France, though, from all accounts, it is not such an easy matter to get the necessary licences, and importers in France have to adhere strictly to the quantities that are allocated to them.

Schedule Prices.

From time to time there has been a good deal of talk in coal market circles respecting the question of existing schedule minimum prices undergoing revision; that is, revision in the direction of being reduced so as to enable competition to be better faced. It was thought at one time that small coals especially would have been brought down in price, considering the enormous standing stocks, but nothing has been done, and coalowners are averse to the subject being discussed openly for the reason that the mere suggestion of any reduction being made only encourages buyers to stay their hands. Their attitude is perfectly reasonable and, therefore, it is not wise for anyone to be unduly optimistic regarding the chances of prices coming down. There has, however, been a development regarding the question as it affects best large coals. It may be mentioned that Cardiff large coals are graded into six lists, and the various prices range from 20s. for the very best qualities, by threepenny stages, so that there is a difference of 1s. 3d. between the lowest quotation and the highest. Naturally, when times are bad, as they are now, buyers satisfy their requirements with as cheap an article as they can get, and it follows that if lower grade coals will meet their requirements they are not going to pay the price that is stipulated for the best descriptions, unless nothing but the best will do for them. The consequence is that the best coals have not been getting a fair share of the business being done, and the collieries, the coals of which are classified in group 1, class A, recently applied for a reduction of the minima. The executive council of the South Wales Coal Marketing Association rejected the application, but it was subsequently referred to arbitration. This arbitration concluded last Saturday, and the arbitrator reserved his decision.

Colliery Stoppages.

The announcement is made that only 150 of the 1500 notices which were given by the Tredegar Iron and Coal Company about a fortnight ago to the workmen at its collieries are to become operative, and that the remainder are to continue working on day-to-day contracts. A month ago the company gave notices to 2000 of its workmen, but only 600 men were then dismissed. The Tirpentwys Colliery Company recently decided to close the No. 2 (Big Vein) Pit at the expiration of the notices to the men at the end of this week. Altogether close on 500 men are affected, and, unfortunately, it is not expected that more than a small proportion of the men will be absorbed in the larger No. 1 pit.

Sheet Mills Reopen.

The Llanelly sheet mills were due to restart at the beginning of this week, after being idle for nearly twelve months. This establishment, which adjoins the Llanelly Steel Company's works, is one of six mills and was built about two years ago on the most modern lines. It is understood that employment will be found for about 250 men this week.

Current Business.

There has been no expansion in operations in coals for early shipment, and the tone of the steam coal market is generally very quiet. Most descriptions of coal are freely available for prompt shipment, but others, owing to the holidays and reduced outputs, are rather scarce. Dry nuts are far from being easily obtainable, and some of the lower grade Admiralty large are comparatively well stemmed for early positions. Small coals, however, are excessive. Coke is a shade steadier and patent fuel works are comfortably off for orders for a week or so. Pitwood was a shade better at 22s. to 22s. 6d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Mr. G. H. Taylor, lately Manchester manager for Messrs. Wheatley Kirk, Price and Co., who have closed their Manchester office, has commenced business on his own account as engineering valuer, arbitrator and estate agent at 16, Albert-square, Manchester.

Matterson, Ltd., machine tool makers and engineers, Shawclough, Rochdale, informs us that Messrs. Hudson Brothers, of 20, West Campbell-street, Glasgow, have been appointed agents for the whole of the firm's specialities for Scotland, and Messrs. M'Gaughey and Fulton, Mayfair Buildings, Arthur-square, Belfast, for the whole of Ireland.

CONTRACTS.

Negretti and Zambra, of Holborn-viaduct, E.C., have received an order to supply many of the boiler-house instruments, including pyrometers, thermometers, and draught gauges for the Brimsdown "B" power station extensions.

Bastian and Allen, Ltd., 26, Cross-street, London, N. 1, have received a contract for an "Electrode" steam boiler installation from James Craig (Glasgow), Ltd., for their new restaurant in Gordon-street, Glasgow. The installation is being carried out under the direction of Mr. J. S. A. Primrose, M.I.E.E., consulting engineer, Glasgow.

CATALOGUES.

Hopkinson's, Ltd., Huddersfield.—"Parallel Slide Valve List No. 3135."

George Fletcher and Co., Ltd., Masson Works, Derby.—Particulars of colliery plant.

Babcock and Wilcox, Ltd., Babcock House, Farringdon-street, E.C. 4.—"The Coal-fired Steamship."

Davies and Metcalfe, Ltd., Romiley, near Manchester.—A 36-page descriptive brochure on the D. and M. vacuum brake ejector.

Hadfields, Ltd., Sheffield.—Illustrated pamphlet No. 325 of Hecla "A T V" steel for steam turbine blades and steam fittings.

Ruston-Bucyrus, Ltd., Lincoln.—A catalogue of the new No. 4 universal half-yard excavator, illustrating some of the types of work these machines are doing.

Gwynnes Pumps, Ltd., Hammersmith, W. 6.—Illustrated particulars of "R" type "Invincible" centrifugal pumps and "G.D." type Gwynne-Doulton acid pumps.

Igranic Electric Company, Ltd., 149, Queen Victoria-street, E.C. 4.—Publication No. 6717, entitled "Not Foolish or Extreme," describing a large number of the push-button and automatic master switch controls made by the firm.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	14/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 10 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 1 0	3 1 0
No. 1	3 1 6	3 1 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
Midlands—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	5 0 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	9 7 6 to 10 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/3 to 13/6
Block Tin (cash)	£111 12 6
„ (three months)	£114 2 6
Copper (cash)	£32 6 3
„ (three months)	£33 3 9
Spanish Lead (cash)	£11 17 6
„ „ (three months)	£12 1 3
Spelter (cash)	£11 6 3
„ (three months)	£11 18 9
Manchester—	
Copper, Best Selected Ingots	£36 0 0
„ Electrolytic	£37 0 0
„ Strong Sheets	£66 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	£13 7 6
„ Foreign	£12 0 0
Spelter	£12 2 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11¼ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 12 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 17 6	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£30 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£35 10 0	14/-
„ „ „ carbon free	9¾d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	8/9 per lb.	

FUELS.

SCOTLAND.

	Inland.	Export.
Lanarkshire—		
(f.o.b. Glasgow)—Steam		13/6
„ „ Ell		14/3
„ „ Splint		14/6 to 15/9
„ „ Trebles		12/- to 12/6
„ „ Doubles		11/6 to 11/9
„ „ Singles		10/6
Ayrshire—		
(f.o.b. Ports)—Steam		13/6
„ „ Jewel		17/-
„ „ Trebles		12/6
Fifeshire—		
(f.o.b. Methil or Burntisland)—Steam		10/6 to 12/6
Screened Navigation		16/6 to 17/6
Trebles		12/- to 13/6
Doubles		12/-
Singles		10/6
Lothians—		
(f.o.b. Leith)—Best Steam		11/-
Secondary Steam		10/6
Trebles		12/6
Doubles		12/-
Singles		10/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/-
Household		30/- to 51/-
Coke		20/- to 20/6
Northumberland—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		7/6 to 8/-
Unscreened		12/6 to 13/-
Household		27/- to 39/-
Durham—		
Best Gas		14/6
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		24/-
Sheffield—		
Best Hand-picked Branch	24/6 to 25/6	—
Derbyshire Best Bright House	19/- to 20/-	—
Best House Coal	18/6 to 20/-	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	14/6 to 15/-	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/6	—
Smalls	4/- to 5/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 13/- to 14/-		

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/3
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/9 to 18/-
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/9 to 20/-
Pitwood (ex ship)	22/- to 22/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Situation.

THE announcement that the Compagnie du Nord has decided to suspend the orders for rolling stock that were to be given out this year has caused serious concern to locomotive and wagon builders, who were already prepared for a shortage of work through the cut in railway expenditure, and there are at present very few orders to replace those now under execution. It is feared that the end of the year will see a considerable reduction in the number of hands employed. The experience is the same in shipbuilding and mechanical engineering, and manufacturers are now all looking to the State to help them by facilitating the carrying out of public works at home and in the colonies. The only source of activity is that provided by the requirements for national defence. In the steel trade a favourable feature is the further renewal of the Cartel until the end of September, with the same quotas of production, but as the penalties for exceeding the quotas have been suppressed, the Cartel can only exercise a moral effect. Nothing further can be done until German steel-makers are in a position to resume negotiations.

Compagnie Generale Transatlantique.

At its annual meeting the Compagnie Générale Transatlantique could only pass the accounts, which show a deficit of nearly 30½ million francs, and accept the conditions imposed by the Government for its reorganisation. On asking the Government for a five years' moratorium, the company received an ultimatum to the effect that the old board of directors should resign and be replaced by one chosen by the State, which also required a voting majority and a mortgage on the company's property to guarantee a loan of 160 million francs. Another mortgage covers 145 million francs due to the Chantiers de Saint-Nazaire, which are constructing the 70,000-ton liner. The new board of directors includes representatives of the State, shipowners, shipbuilders, and of the port of Havre. The report naturally attributes the company's losses to the crisis in the North Atlantic carrying trade, and especially to the contraction of receipts from the first-class traffic. At the end of 1930 the company's fleet comprised 104 ships, having a total displacement, with average loading, of 1,052,389 tons. Since the beginning of the year, it has taken delivery of the remaining three of the six cargo boats ordered from Harland and Wolff, as well as a cargo boat from the Chantiers de Normandie and a 12,000-ton passenger ship from the Chantiers de France at Dunkirk. The 28,000-ton "Champlain," for passengers and cargo, which has been built at Saint-Nazaire, will be placed upon the New York service in May next, and the new big liner, which was started in January last, is expected to be put in service in 1934.

Paris Railway Bridge.

The last section of the railway bridge being constructed at the Place de l'Europe, behind the Gare Saint-Lazare, was lowered on the piers last week, and in three months' time it is hoped that this important undertaking will be completed. There are six streets converging on to the Place, which is over the railway where all the main and suburban lines enter the terminus, and as the railway curves at that point the view was obstructed by piers. Some of the piers had to be removed. The old bridge had suffered badly from locomotive fumes, and the new construction, of heavier section, is, therefore, being encased in concrete. The work had to be done without interfering with the railway and road traffic. Each section of the star-shaped bridge was assembled on timber piles and then let down on the stone piers by means of screws and jacks. The part of the bridge placed in position last week weighed 600 tons, or one-tenth of the total weight of the construction. Like the other sections, it was built upon a falsework of timbers, all of the same size and placed crosswise, and at each end there was a gantry with vertical screwed rods terminating below in plates, arranged as flexible links, and riveted to the bridgework. Suspended from the gantries the bridge rested on jacks, which were lowered while the end rods were unscrewed. Then a row of timbers was removed and the jacks screwed up to the suspended bridge and the operation was resumed. The bridge was lowered at the rate of about 4in. an hour.

Light Cruisers.

The two 7500-ton cruisers which are to be put on the stocks this year will show a complete departure from the ideas that influenced the designing of the first 10,000-ton cruisers when protection was sacrificed to speed under the impression that they could keep out of range of more powerful ships. The change began by increasing the belt protection, which will be most effective in the "Dupleix" and "Algérie," the last ships of their class. In the smaller cruisers the armour will be capable of resisting 155 mm. shells from a distance of 15,000 m. It is said that they will be better protected than foreign cruisers of similar displacement. They will have eight 155 mm. guns, together with torpedo tubes and will carry aircraft.

Coal Restrictions.

The control of coal imports by licenses has affected Belgium in the same way as other countries, which send supplies to France, and that has aggravated a serious situation in Belgium, where the industry is suffering from an alleged dumping of coal from Germany and Holland. So far, coalowners, though losing money on every ton of coal sold, have not closed down pits in the hope that Government would do something for them, and as the negotiations with the Kohlensyndikat for a removal of the German embargo on Belgian coal seems to have little chance of a successful issue, coalowners have posted notices terminating the present wages agreement on September 1st. At the same time, with the idea of keeping the home market for Belgian coal, the Government is said to contemplate fixing a maximum quantity of coal to be imported from the respective countries and to impose high duties on anything imported in excess of that quantity.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

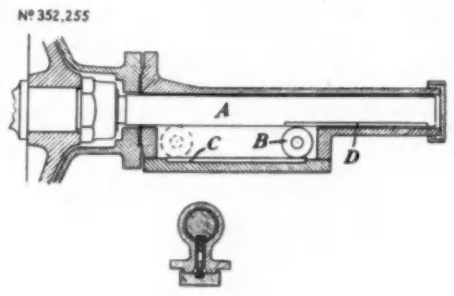
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

352,255. July 10th, 1930.—A ROLLER GUIDE FOR THE TAIL RODS OF HORIZONTAL ENGINES, *L. N. Reddie*, 6, *Breams-buildings, London, E.C.* 4.

The idea of this invention is to support the tail rod of a reciprocating horizontal engine on a roller, much after the fashion of a Stoney sluice, and thus reduce its frictional resistance. The tail

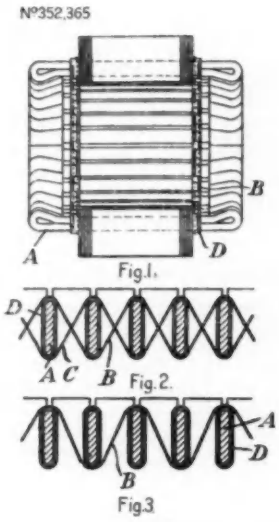


rod is shown at A and the roller at B. The roller runs between hardened races C and D and is of comparatively narrow proportions. The races are half the length of the stroke of the piston and are renewable, as is also the roller, but the opportunity for hardening these parts reduces wear to a minimum.—*July 9th*, 1931.

DYNAMOS AND MOTORS.

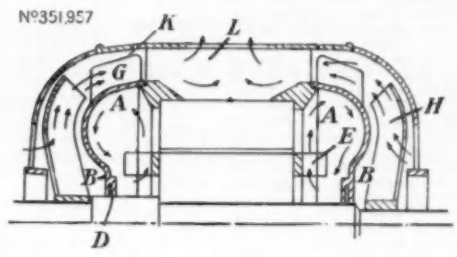
352,365. November 14th, 1930.—WINDINGS OF DYNAMO-ELECTRIC MACHINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

According to this invention, the taping together of the slot sleeves and wedges with the coils of electrical machines is made possible in a simple and cheap manner by lapping a continuous tape round the parts of the winding or the slot sleeves which project from the laminated stator. The laminated stator core—Fig. 1—is provided with a three-phase winding constructed in the usual manner. The parts A of the winding, which project from the slots, are embraced by a continuous tape B, as shown in Figs. 2 and 3. In Fig. 2 the parts A of the winding are embraced alternately on the inner and outer sides by a tape B, while a second tape C is wound in a similar manner, but displaced by one slot, so that the two tapes cross one another each time they pass between the slots and embrace the top and bottom of the parts A of the winding. In Fig. 3 the tape is wound in loop form round each of the parts A of the winding in succession. As shown in Fig. 1, the tapes may also embrace the ends of the insulating sleeves D in order thereby to secure their position relatively to the laminated stator. The tape used for taping may consist in the usual manner of linen or cotton, but twine, metal wire or other suitable material may be used. Instead of the tape being wound in loop form or wave form as shown in Figs. 2 and 3, it may also be wound round the parts of the winding in trapezium form or in any other suitable manner. The invention is particularly useful for three-phase induction motors, but it may also be used with advantage for A.C. motors of other types and also for D.C. motors.—*July 9th*, 1931.



351,957. March 26th, 1930.—DYNAMO-ELECTRIC MACHINES, Karoly Hinterseer and Lipot Laub, both of 41, Csengery utcza, Budapest, VI., Hungary.

In accordance with this invention open and frame-cooled enclosed machines can be constructed in the same manner. The spaces A at both ends of the machine are closed from the outside air on one side by the side walls of the stator stamping packet and on the other side by a partition B. A simple packing D is used between the shaft and the partition B. In the inner spaces at both ends the air is kept in motion in the direction shown by means of either suitably shaped winding ends on the rotor or, in the case of short-circuited windings, by wings E. A fan H is provided at each end, which sets the air in motion in the opposite direction to that of the internal air, so that on account of the difference in direction, and because cool air is used at both ends, the partition B can take up a comparatively large amount of heat. The partition B is provided with ribs G or corrugated surfaces. After the air stream caused by the fans H has cooled the partitions B, it passes through the opening K and in the

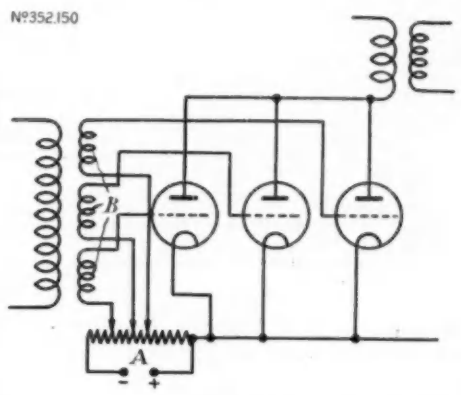


arrangement shown flows past the back of the stator stamping packet, cools its outer surface directly, and then escapes from the housing by the opening L. In the open construction the partitions B are not used.—*June 26th*, 1931.

TELEGRAPHS AND TELEPHONES.

352,150. May 8th, 1930.—THERMIONIC VALVE CIRCUIT ARRANGEMENTS, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2; and William Herbert Peters, of Research Laboratories of the General Electric Company, Ltd., Wembley.

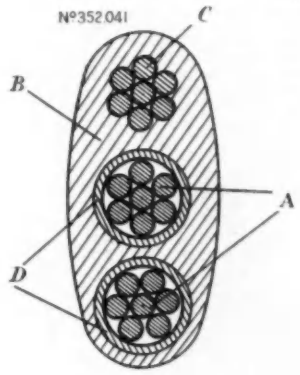
As the characteristics of thermionic valves are not identical, it is difficult to run several valves in parallel. If the grid electrodes are joined in parallel and fed from a transformer by a single winding, one valve generally takes all the load while the remainder are idle. In accordance with the invention the valves shown have their grids connected through a secondary winding of a transformer to a tapping on the common grid bias supply A, so that each grid has a separate grid bias supply. The transformer has a single primary winding and the three secondary windings B are wound side by side similarly on the same core.—*July 9th*, 1931.



TRANSMISSION OF POWER.

352,041. February 5th, 1930.—ELECTRIC CABLES, Alfred Wilson Clegg, of "Woodside," Whalley-road, Clayton-le-Moors, Accrington.

This invention has reference to electric cables of the type in which conductors insulated with vulcanised rubber are laid up together and encased in a sheathing of india-rubber or other material. In such cables it is common practice to lay up with the insulated conductors within the outside casing a bare conductor to be used as an earthing conductor. Under some conditions there is a tendency for the bare conductor to become corroded and destroyed by acid products extracted from the insulation in the presence of moisture. The main object of the invention is to remove this tendency and afford the same general protection to the earthing conductor as to the insulated conductors. In the drawing A are the insulated conductors and D the insulation. B is an outside sheathing composed of the material commonly known as cab tire rubber, and C is the earthing conductor.—*July 6th*, 1931.

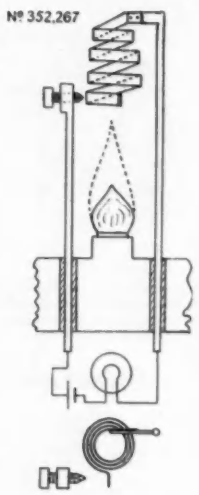


MEASURING AND TESTING INSTRUMENTS.

352,267. July 15th, 1930.—APPARATUS FOR DETECTING AND INDICATING THE PRESENCE OF INFLAMMABLE GASES IN AIR, C. McLuckie, 69, Mesnes-road, Wigan, Lancs.

This invention is in the nature of a gas detecting and indicating device for detecting and indicating inflammable gases in mines and such places. It is put into operation through the medium of a flame which may be contained in, say, a safety lamp, with a bi-metallic spiral placed above the flame. The

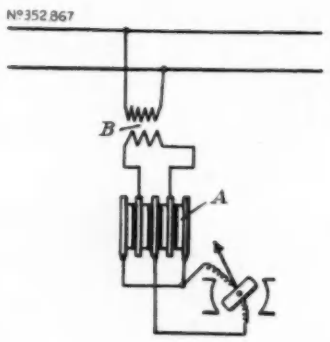
spiral is made from two dissimilar metals joined together and formed into the shape of a spiral, cone or cylinder. One end of the bi-metallic strip is fixed and the other end is free to move. The top end of the bi-metallic strip may be conveniently fixed to a pillar or support. The remaining portion of the strip can be coiled up in the form of a spiral and placed at a convenient height above the flame of the lamp. With a flame of normal height the position of the free end of the bi-metallic strip will remain constant, but should the flame increase in height owing to the presence of inflammable gas or vapour in the air, the spiral will suffer a rise in temperature, and consequently the free end of the spiral will move. The movement produced at the free end of the spiral can be utilised to operate any form of visual or audible alarm or indicator, such as coloured lights, horns, bells, &c., or to operate through the necessary mechanism switches in power circuits so that the electric current can be cut off when dangerous quantities of inflammable gases are present. By coiling the bi-metallic strip into the form of a spiral it assists in ventilating the flame, the spiral acting as a small chimney; consequently the products of combustion passing up through the chimney readily heat the spiral, and any variation in the temperature of the flame is readily indicated by the movement ofthe free end of the spiral.



Under normal working conditions in air free from inflammable gases and vapours the flame in the lamp will be of a standard height and width, but when inflammable gases are present the flame increases in height and consequently the bi-metallic spiral suffers in rise in temperature.—*July 9th*, 1931.

352,867. November 12th, 1930.—Dry Plate Rectifiers for Measuring Alternating Current and Voltage, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

According to this invention the temperature error introduced by metal rectifiers supplying current to moving coil instruments is reduced by using rectifiers with a plate surface smaller than

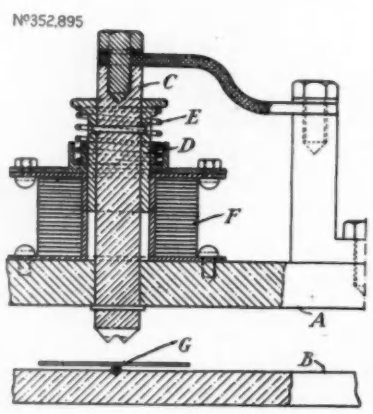


1·5 square centimetres. Experiments have shown that the temperature error becomes substantially less owing to the relatively greater current loading according to the invention. The oxide rectifier A is connected as shown. The voltage transformer B does not constitute any essential part of the invention, as by suitably dimensioning the rectifier it can be connected direct to the line.—*July 16th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

352,895. January 20th, 1931.—Electrical Welding Machines, Vereinigte Stahlwerke Aktiengesellschaft, 67/69, Breitestrasse, Düsseldorf, Germany.

The invention relates to electrical apparatus for welding wire netting at the crossing points and also to any type of wiring so welded together. A and B are two plates held at a variable distance apart by screw-threaded bolts. Current at the necessary voltage is supplied to the plates by a stationary transformer. The wires at the point G where they cross rest upon the plate B

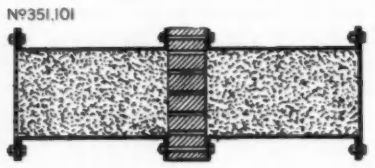


and an electrode C is connected to the plate A. As long as the magnet coil F is not energised, a helical spring E presses an iron sleeve D upwards. If current is passing through the coil F the sleeve D and the electrode C are drawn into the coil F until the lower end of the electrode C bears upon the crossed wires G and produces the weld. For welding wire netting an apparatus of this type is provided at each weld point and the magnet coils are connected to the segments of a control device in such manner that any desired number of welds can be effected simultaneously or in a definite sequence.—*July 16th*, 1931.

MISCELLANEOUS.

351,101. March 27th, 1930.—A Device for Arresting Explosions in Gas Pipes, H. Grohmann and Elektrochemische G.m.b.H., Hirschfelds, Saxony.

In order to prevent an explosion being propagated along, for instance, a pipe used for the conveyance of acetylene, the inventors place a substantial barrier in the pipe. This barrier is



perforated with fine holes, having such a cross-sectional area that they do not appreciably restrict the normal flow of the gas. On either side of the barrier there is packed loosely a mass of filling material, such as metal filings, flour of sulphur, and ammonia alum, or a mixture of those substances. In the event of an explosion taking place this mixture is compacted by the sudden impact and through a combination of mechanical and chemical action checks the explosion.—*June 25th*, 1931.

351,884. November 20th 1930.—Pipe Joints, Stewarts and Lloyds, Ltd., 41, Oswald-street, Glasgow, and D. Devine, 28, King's Park-avenue, Cathcart, Glasgow.

Another joint for piping subjected to high pressures. The end of the pipe itself is formed into a flange or what is described in

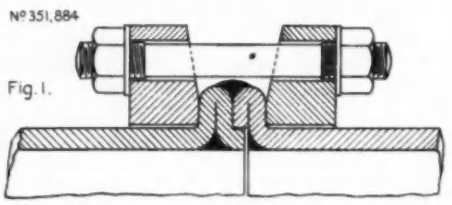
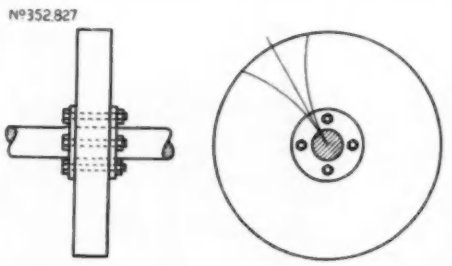


Fig. 2.

the specification as a "flattened corrugation." The process of producing this corrugation is not disclosed. The parts are then machined away, as indicated in Fig. 2, and the two pieces of pipe are clamped together by loose rings and bolts, as shown. Tightness is ensured by gas or electric welding.—*July 2nd*, 1931.

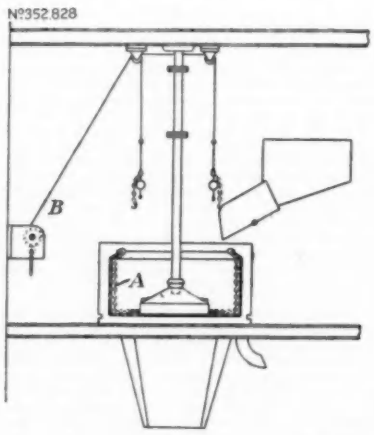
352,827. September 27th, 1930.—An Oscillation Damper for Shafts, O. Föppl, Bernerstrasse 10, Brunswick, Germany.

This invention seems to aim at overcoming a defect which should not occur in a properly designed machine, and is specifically mentioned in connection with aero-engines. It is suggested that the crank shafts of such engines may be subject to vibration, or "oscillation," as it is described in the specification, and this trouble is overcome by mounting on the shaft a disc of resilient material, such as rubber, the proportions of which are calculated so that its periodicity is equal, or approximately equal, to that of the shaft. The illustration needs no explanation.—*July 16th*, 1931.



352,828. September 29th, 1930.—Centrifuging Ammonium Sulphate, N.V. Silica en Ovenbrow Mij, 17, Raamweg, The Hague, Holland.

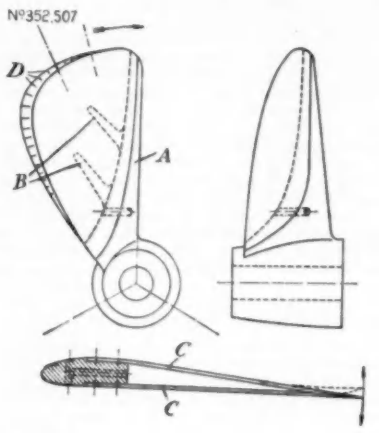
After crystaline ammonium sulphate has been produced in a by-product plant, it is usually dried by centrifuging, and some labour is necessary for extracting the cake of sulphate from the



basket of the centrifuge. The inventors consequently drop a system of chains A into the basket before it is charged. These chains naturally lie against the sides of the basket on account of centrifugal action, and when they are drawn up by a winch B at the end of the drying process, they cut up the cake, so that it is easily removed.—*July 16th*, 1931.

352,507. April 10th, 1930.—Screw Propellers with Flexible Blades, F. Melcher, 146, Geutzgasse, Vienna XVIII., Austria.

The shape of the blades of this propeller is similar to that of an ordinary screw propeller of stream-line section. The construction imitates to a certain extent a bird's wing. The rigid forward rib of each blade is formed in conjunction with the boss of the propeller in the manner of a helicoidal surface in order that it may serve as a bearing surface for resilient blade leaves or plates, which are attached thereto either in single or in multiple



thicknesses. These blade plates are applied to both sides of the forward rib, and are sprung together at their outer edges under their own tension, thus forming together with the forward rib a hollow chamber, which is provided with communication apertures designed to effect an equalisation of pressure, and thereby the avoidance of cavitation at the blade tip. The illustrations show a propeller blade with the forward rib at A, reinforced by flexible stiffening arms B B and the resilient plate C C. The more extended of these plates is cut with slits D to provide local resilience and to reduce the formation of eddies at the edge.—*July 10th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

THURSDAY to SATURDAY, SEPTEMBER 3rd to 12th.

"Model Engineer" Exhibition.—Royal Horticultural Hall, Westminster, S.W. 1. Daily.

SUNDAY to SATURDAY, SEPTEMBER 6th to 12th.

International Association for Testing Materials.—Congress at Zürich.

THURSDAY to SATURDAY, SEPTEMBER 10th to 26th.

Shipping, Engineering and Machinery Exhibition.—Olympia, W. Daily, 11 a.m. to 9 p.m.

SATURDAY to WEDNESDAY, SEPTEMBER 12th to 16th.

International Foundry Congress.—Milan.

SATURDAY to SUNDAY, SEPTEMBER 12th to 27th.

International Foundry Exhibition.—Milan.

SUNDAY to FRIDAY, SEPTEMBER 13th to 18th.

Institute of Metals.—Autumn meeting at Zürich. For programme see page 21.

FRIDAY to SUNDAY, SEPTEMBER 18th to 20th.

National Smoke Abatement Society.—Annual Conference at Liverpool.

FRIDAY to MONDAY, SEPTEMBER 18th to 21st.

Association of Special Libraries and Information Bureaux.—At Lady Margaret Hall, Oxford. Eighth annual conference. Friday evening, presidential address, by Professor A. M. Carr Saunders.

WEDNESDAY to FRIDAY, SEPTEMBER 23rd to 25th.

Institution of Mining Engineers.—Manchester. Postponed summer general meeting.

TUESDAY to FRIDAY, SEPTEMBER 29th to OCTOBER 2nd.

Iron and Steel Institute.—Autumn Meeting at Swansea. For programme see page 105.

Correction.—In our issue of July 17th, referring to the exhibits of Manlove, Alliott and Co., Ltd., at the British Chemical Plant Exhibition, we credited the origination of the design of a multiple leaf filter to Mr. Hatfield, of Messrs. Achille Serre, Walthamstow. We understand that, while the process employed was originated by Mr. Hatfield, the actual design of the filter used was developed and patented by Manlove, Alliott and Co., Ltd.

The Institution of Electrical Engineers.—The following scholarships have been awarded by the Institution of Electrical Engineers for 1931:—Duddell Scholarship (annual value £150, tenable for three years): C. H. W. Clark, Sevenoaks Grammar School. Silvanus Thompson Scholarship (annual value £100, plus tuition fees, tenable for two years): C. H. Lackey, Messrs. A. Reyrolle and Co., Ltd. David Hughes Scholarship (value £100, tenable for one year): G. L. d'Ombrain, City and Guilds (Engineering) College. Salomons Scholarship (value £100, tenable for one year): S. H. Padel, Manchester College of Technology. War Thanksgiving Education and Research Fund (No. 1), grants of £50 each to: F. J. Clark, East London College; J. H. Wagstaff, University College, London. Thorrowgood Scholarship (annual value £25, tenable for two years): P. W. Ottley, the Underground Electric Railway Company of London, Ltd. Paul Scholarship (annual value £50, tenable for two years): W. T. Darwin, L.C.C. School of Engineering and Navigation.